Volume 29 FEBRUARY, 1923 Number 6

MACHINERY

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VOLUME 29 **MACHINERY** NUMBER 6

FEBRUARY, 1923

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Screw Machine Products Made in Three Seconds, or Even Less, will be the leading article in March MACHINERY — an interesting record of the efficiency and speed of modern automatic machine equipment

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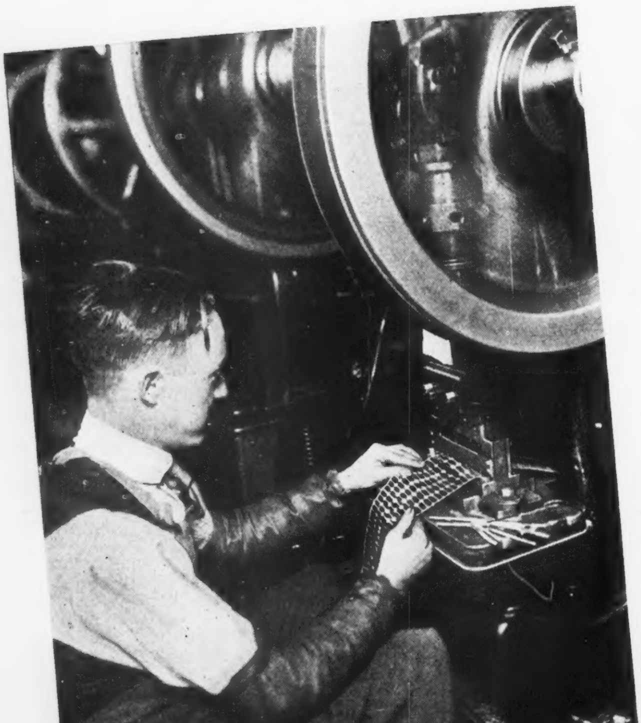
MACHINERY Covers the Field

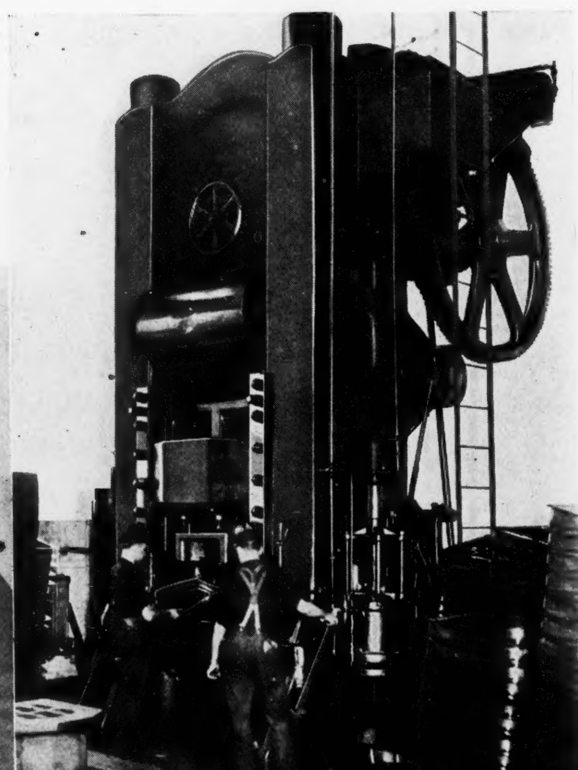
More about Presses and Dies

The current number of MACHINERY contains the final installment of the series of special articles on Presses and Dies, the first of which, in January MACHINERY, has aroused much interest. The five additional articles featured this month will make equally valuable and interesting reading to all engaged in the metal working industry:—See "Pressed Steel Machine Handles," "Punching Rotor and Stator Laminations," "Making Gears on the Punch Press," "Knuckle-joint Embossing Presses" and "Drawing Sockets for Wrenches."

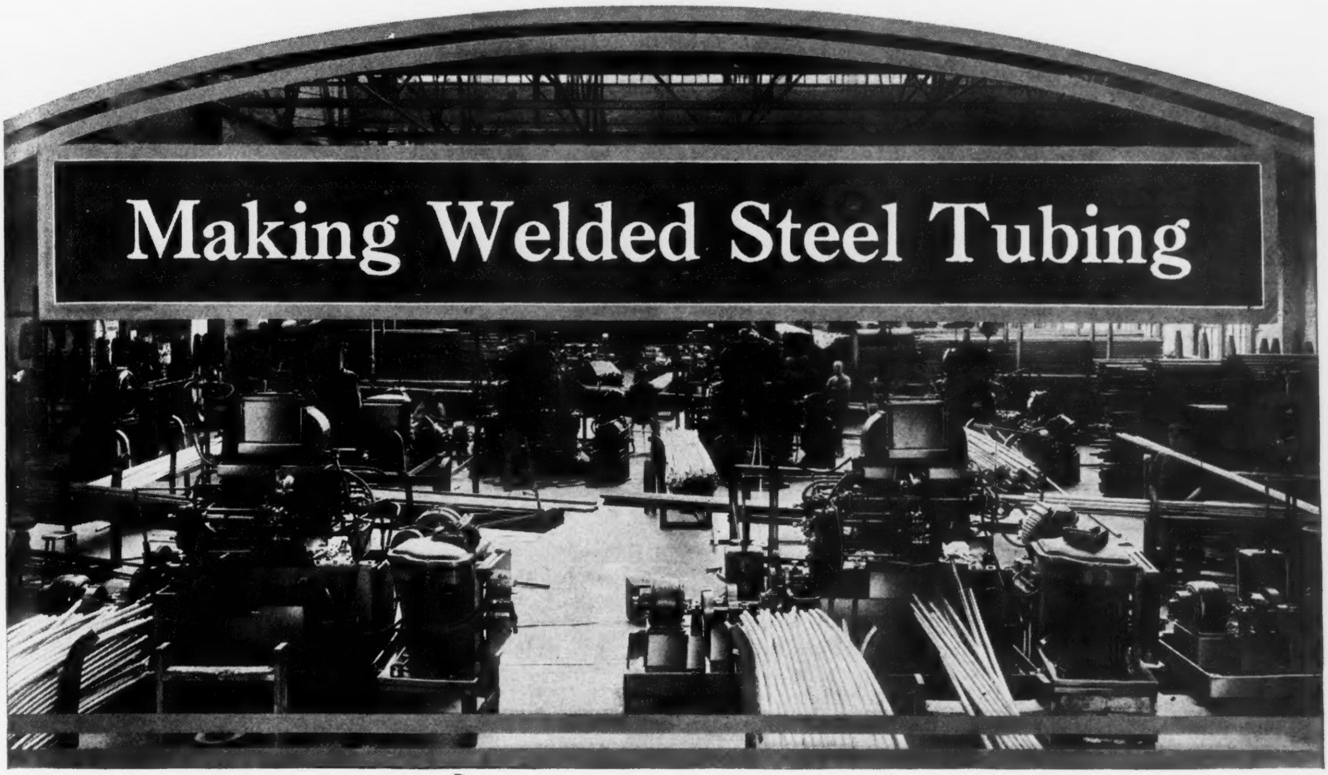
The articles on general subjects in February will be found interestingly diversified:—Some of the more important titles are "Making of Welded Steel Tubing," "Methods of Generating Helical Gears," "Dies for Die Castings," "Milling Automobile Connecting Rods," "Grinding a Cam Slot in a Reference Gage," "Using the Turret Lathe for Small Lots," "Tool Sales and Service Records."

February MACHINERY complements the January number and carries us forward into a year that bids fair to make history in metal working lines.





Making Welded Steel Tubing



Rolling the Tubing—Welding by Electric or Oxy-acetylene Process—Finishing the Welded Seam

By EDWARD K. HAMMOND

IN the manufacture of tubular pieces, such as steering columns, exhaust pipes, radius-rods and other automobile parts, as well as a variety of products for other industries, welded tubing is used in great quantities. The Standard Welding Co., Cleveland, Ohio, started to manufacture tubing in the days when the bicycle industry was at its height, and still supplies a large proportion of the material for frames, forks, and handle bars in that industry. The development of this department to its present size has gone hand in hand with the growth of the automotive industry, for there are no less than fourteen units in the chassis of an automobile for which this material is used. Welded tubing of the kind produced by this concern is made from flat stock, which is rolled into tubular form and then welded along the seam. In each case the material is delivered in the proper widths so that when it is rolled into shape the tube will be of the required diameter.

The tubing is rolled by a progressive set of forming rolls, as illustrated in Fig. 1. The approximate shape of the stock after it has passed between each pair of rolls is indicated in Fig. 3. The machine shown is equipped for forming round tubing, but this company also manufactures square tubing and other shapes. From Fig. 1 it will be understood that the strip steel from which the tubing is made is fed to the machine from a coil.

Various lengths are required, depending upon the use that is to be made of the tubing or the specifications of the customer. In order to obtain the proper length, the formed tube is run out of the machine on a bench which is marked in such a way that the operator can stop the machine when the end of the tube has reached a specified point and then cut off this length of tubing. The machine is then started again. This procedure is repeated until the complete coil of ribbon stock has been converted into tubes of the required length. Some customers order tubing with their company's name imprinted on it at specified intervals. When this is the case, a roll with the name embossed on it is set up on the machine ahead of the first pair of form rolls. This embossed roll is actuated in such a way that it is intermittently pressed against the stock as it passes through the machine.

After the tubes have been formed in this manner, the next operation is to weld the seam. Two different machines are employed for this purpose, one of which utilizes

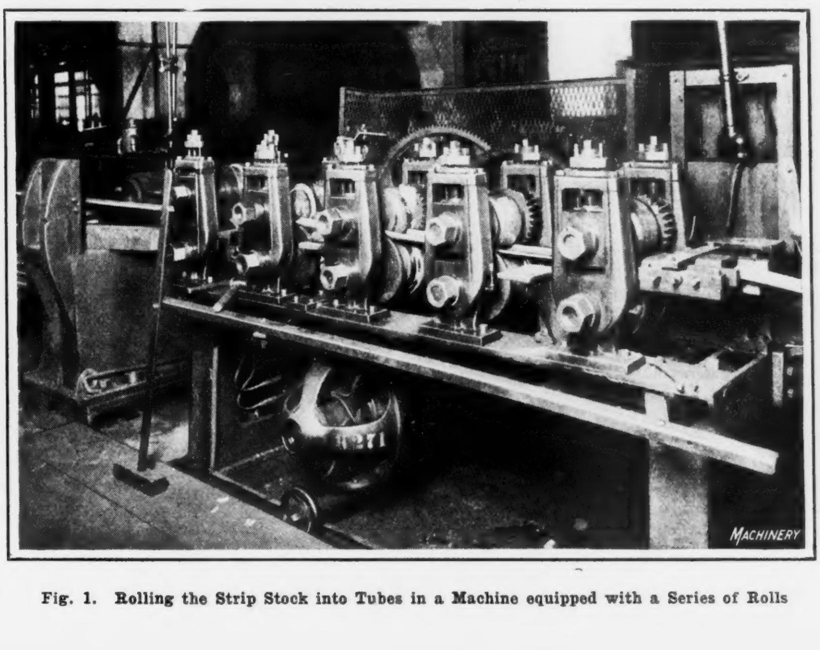


Fig. 1. Rolling the Strip Stock into Tubes in a Machine equipped with a Series of Rolls

electric current, and the other an oxy-acetylene flame. Both these machines are equipped with a feeding device to pass the tube under the source of heat and thus give continuity to the welded seam.

No metal is added in forming the weld in either the electric or the oxy-acetylene machine. In other words it is not the practice to melt metal from the end of a wire and allow it to flow into the joint as is often done in certain classes of welding. In the manufacture of steel tubing, as followed at the plant of the Standard Welding Co., the process is purely one of pressure welding, in which the application of heat raises the temperature of the steel to a point where cohesion is produced by the application of pressure.

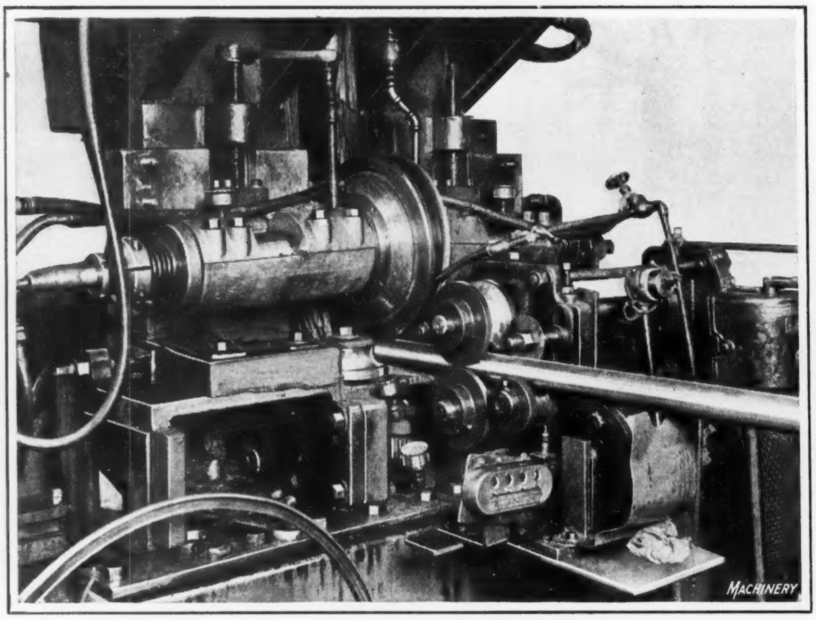


Fig. 2. Feeding Side of the Electric Welding Machine

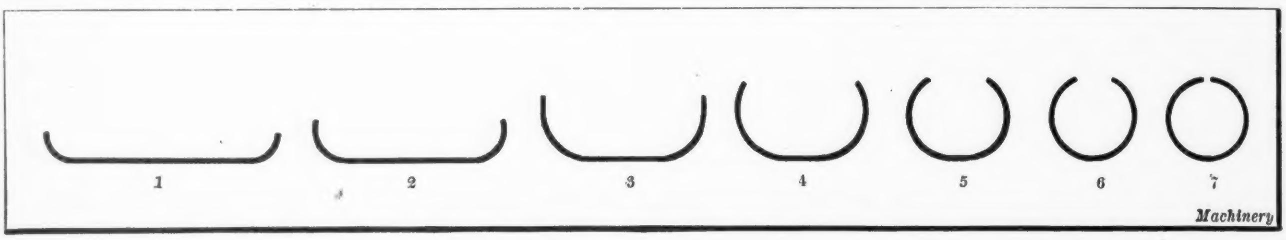


Fig. 3. Evolution of Tubing from Flat Stock

Fig. 2 shows a close-up view of one of the electric welding machines in operation, and Fig. 4 shows the relation of the rolls and work during the process of welding. This machine contains pairs of traction rolls arranged at right angles to each other, which feed the tube through the machine. There is also a pair of large copper rolls which run in contact with the tubing at the point of welding, one of these rolls being the positive and the other the negative terminal of the electric circuit. The position of the welding rolls is shown in Fig. 4. A circular blade or spreader slides in the space between the two edges of the seam, thus serving the double purpose of guiding the tubing through the machine with the seam at the top, and keeping the two edges of the seam separated from each other until they reach a point directly beneath the copper welding rolls. The copper rolls, due to their design and angular position, press the edges of the seam into contact to facilitate welding, as the diagram shows.

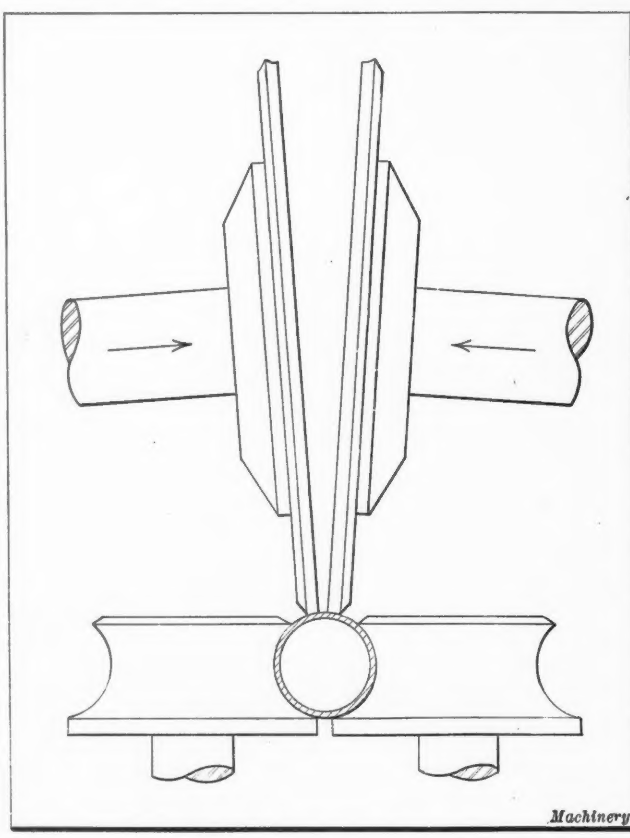


Fig. 4. Position of Welding and Feeding Rolls Relative to Work

The machines that use the oxy-acetylene flame for welding, instead of electric current, are to all intents and purposes exactly the same in design and operation as the electric welding machines. There are the traction rolls (see Fig. 6), which feed the work through the machine, and a blade which guides the tube through the machine with the seam at the top, and keeps the edges spread apart until they reach the welding point. But on these machines, the heat is supplied by an oxy-acetylene torch A of special design, which has orifices in it from which flames impinge upon the seam at the point where it is being welded.

Various methods are employed for removing the slight roughness along the surface of the welded seam, according to the purpose for which the finished tubing is to be used. Fig. 7 shows a machine for handling electrically welded tubing. It will be seen that the machine is furnished with a series of rolls which feed the tubing past three blades that take successive shearing cuts to remove the surplus metal along the seam. These feeding rolls are staggered in such a way that they also serve as straightening rolls.

Another method of finishing the seam in the tubing consists of grinding the entire length of the joint, and in still other cases a practice is made of simply grinding the points where the seam appears to be unusually rough. When an exceptionally fine finish is required, the tubing may be ground all over, in addition to removing the surplus stock at the seam.

If the surplus metal is not removed from the seam by a combination machine

of the type shown in Fig. 7, the tubing must be straightened in a separate operation, as illustrated in Fig. 5. This machine is provided with a yoke mounted on hollow trunnions through which the tubing is passed. Carried by the yoke there is a series of staggered rollers between which the tubing passes before emerging through the hole in the hollow trunnion at the opposite end. In operating this machine, the yoke revolves around the tubing, and the staggered rollers carried by it apply the necessary pressure to straighten the tube.

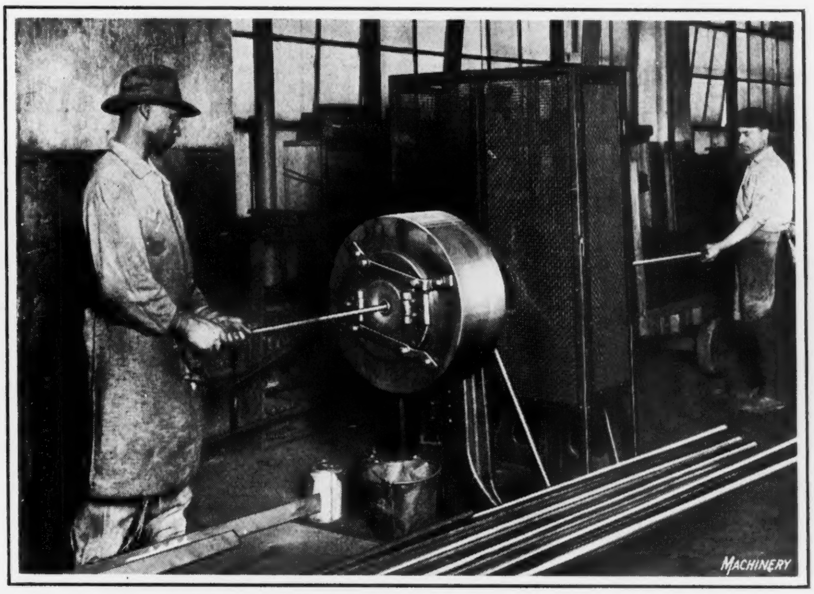


Fig. 5. Straightening Tubing in a Separate Operation

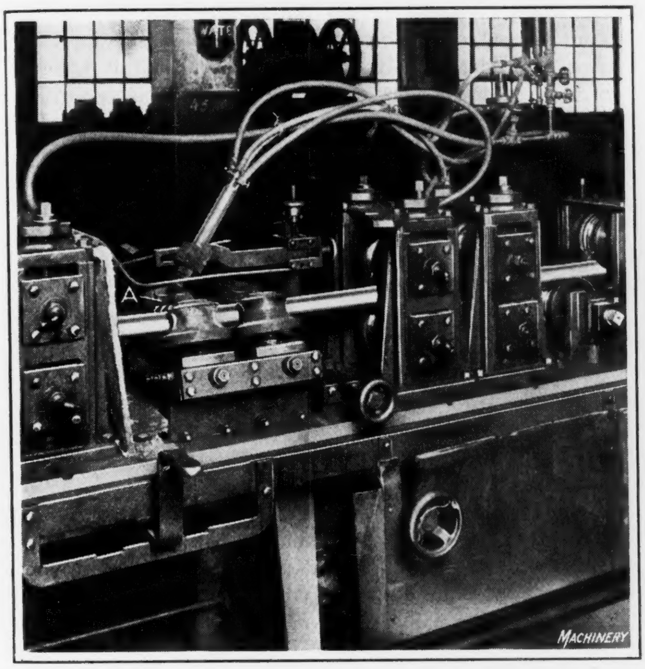


Fig. 6. Oxy-acetylene Machine for welding the Tubing

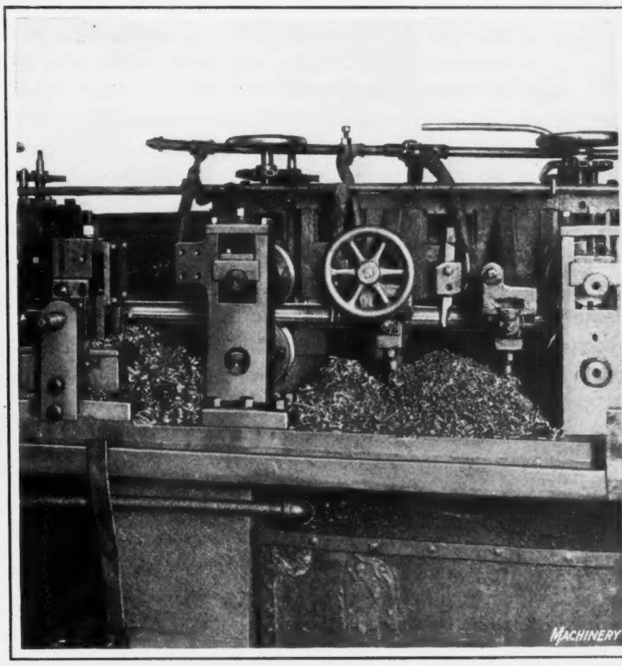


Fig. 7. Machine for finishing the Surface of the Welded Seam

Uses of Welded Steel Tubing

Mention was previously made of the fact that tubing is used by this company in the production of various products. Although it is not within the scope of this article to enter into a detailed description of the way in which such parts are made, it may be of interest to refer briefly to the procedure followed in bending the tubing, which is necessary in the manufacture of many tubular parts. In bending, there would be a tendency to crush the tube unless it were supported from the inside, and this is accomplished by filling the tube with melted rosin.

The tubes to be bent are placed vertically in a rack and paper plugs are inserted in the lower ends. Then melted rosin is poured in at the top until each tube is full. After the rosin has solidified, the bending is accomplished, either by bulldozers equipped with suitable dies or by bending rolls. Fig. 8 shows a bulldozer being used for the final operation on an automobile exhaust pipe. The operation consists of upsetting a flange at one end. All the other bends in the pipe were made previous to this on bulldozers equipped with dies of the required form. After all the bends have been made, the tubes go back to the department where they were filled with rosin. Here they are stood endwise over a trough and heat is applied with a torch so that the rosin melts and runs out.

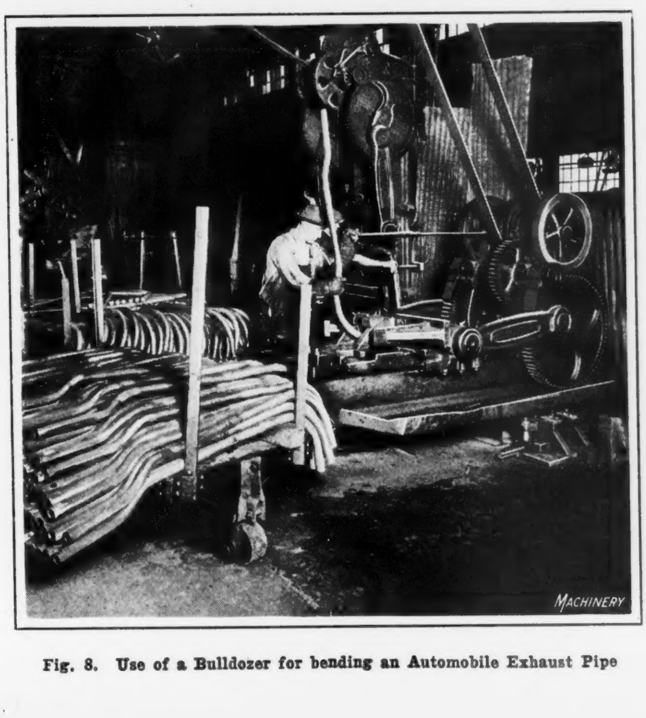


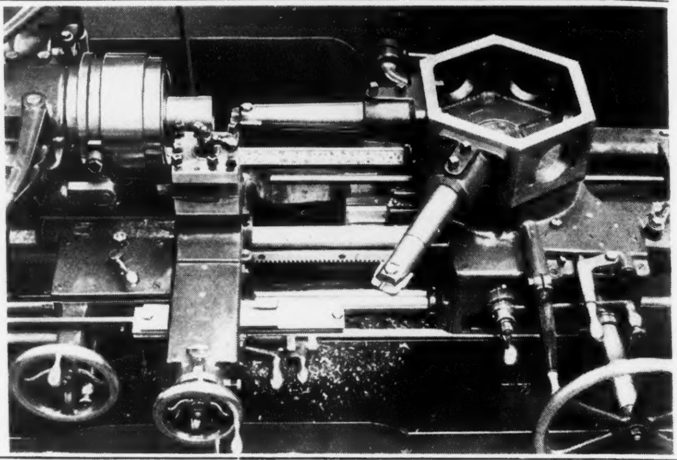
Fig. 8. Use of a Bulldozer for bending an Automobile Exhaust Pipe

The possibilities in the after-fabrication of welded tubing are quite varied. It can be bent to different radii, or swaged to varying diameters in one piece. Great accuracy as to gage and diameter may be secured.

Using the Turret Lathe for Small Lots

Examples Showing How Small Quantities of Castings and Forgings can be Machined Economically on the Turret Lathe

By ALBERT A. DOWD, President
Dowd Engineering Co., New York



THE suitability of the turret lathe for machining parts from bar stock when only a limited number of one kind is required was dealt with in the article "Using the Turret Lathe for Small Lots" in December MACHINERY. The value of this type of machine for small lots is not often recognized, and, in consequence, turret lathes frequently remain idle in many plants, when they could be profitably employed on duplicate work being produced on engine lathes. Work that is held in a chuck while being machined on a turret lathe, such as castings and forgings, presents more problems than bar work, and as there are frequently only a few pieces in a lot, the manufacturer often considers that it can be handled more economically on an engine lathe. In reality, much of this work can be handled more advantageously on a turret lathe equipped with adjustable standard tools. By selecting these tools judiciously, it is possible to machine a large variety of chuck work at a minimum cost.

It is of first importance that the operator be able to work with little loss of time or error in judgment in selecting the method he intends to use for a given piece of work. The handling of this work, of course, is entirely different from the normal production methods employed on the turret lathe. Tools on the cross-slide turret may be used to turn the different diameters on the first piece, and then, while the work remains in the chuck, the various tools on the hexagon turret can be easily set to the finished diameters. The stops for determining the different lengths of cuts can finally be adjusted to facilitate the machining of the remaining pieces in the lot.

Several examples of work that can be economically produced in small lots on the turret lathe are shown in Fig. 1. These parts are finished all over, with the exception of parts *C* and *D* on which the surfaces to be machined are indicated by finish marks. On casting *A*, the concentricity of the hole and the external cylindrical surfaces are not of great importance, but the diameter of the hole must be within ordinary commercial limits. Example *B* is a solid steel forging having a center hole about 1/4 inch smaller in diameter than the finished hole, drilled through it before it is brought to the turret lathe. The example shown at *C* is a steel casting. The flywheel pulley *D* is made of cast iron, and part *E* is a forging which comes from the hammer as a solid steel billet forged roughly to shape on the outside. Collar *F* is made of bronze and threaded on the outside cylindrical surface after all surfaces have been finished. The tooling equipment used in machining each of these pieces is described in the following.

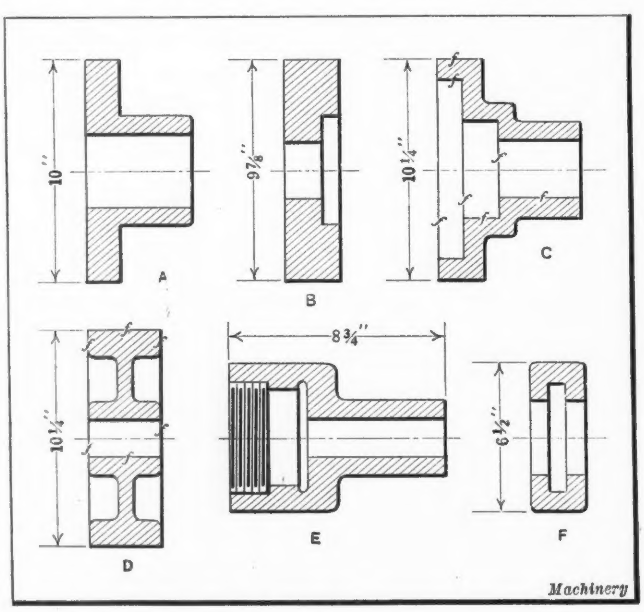


Fig. 1. Examples of Castings and Forgings that can be machined profitably in Small Lots on the Turret Lathe

Selection of Tooling Equipment

It will be assumed that the parts shown in Fig. 1 are machined on a turret lathe built by the Warner & Swasey Co., Cleveland, Ohio. Fig. 2 shows a flexible lay-out of standard tools for such a machine, suitable for handling a considerable range of chuck work. Tools *A*, *B*, and *C* are standard turning and facing heads, so designed that boring-bars *E*, *F*, and *G* can be used in connection with single or multiple cutter-bars *H*, *K*, and *L*. Each turning and facing head has holes at various distances from the center to accommodate these cutter-bars. This provision makes it possible not only to set up tools to turn several surfaces at one time, but also to determine shoulder distances with precision when it is necessary to set the bars forward or backward.

The vertical slide tools *M* and *N* are utilized for boring, back-facing and recessing, and as they have two holes for bars, it will be seen that a number of different conditions can be met. The slides have a micrometer dial, which facilitates the making of accurate settings. The last turret face is provided with a standard tool-holder *O* intended to hold a boring-bar, reamer, or special tool. All tools in this set-up can be readily removed and replaced in a short time to enable parts of unusual shape to be handled. However, the flexibility of the equipment is such that many pieces can be handled without any change except in the adjustments of the cutting tools. The square toolpost

or turret of the cross-slide carries forged tools *P*, *Q*, *R*, and *S*. These may be used for turning, facing, or grooving, as the occasion requires, and can be quickly and easily replaced when special tools are necessary.

The first operation in machining part *A*, Fig. 1, consists of boring the hole by means of a cutter in boring-bar *E*, Fig. 2, turning the cylindrical body with the adjustable tool in holder *H*, indexing the turret, finish-boring the hole with the tool in boring-bar *F*, and finish-turning the body with the tool in holder *K*. While these cuts are being taken, the end of the piece is rough- and finish-faced by tools *P* and *Q* on the cross-slide turret. After these cuts have been taken on the first part in a lot, the turret and cross-slide stops are set so that all parts of the same lot can be readily machined to the same dimensions. For this job the lathe is equipped with a three-jaw universal chuck having hardened removable and reversible top jaws. These can easily be replaced by soft or special jaws when needed.

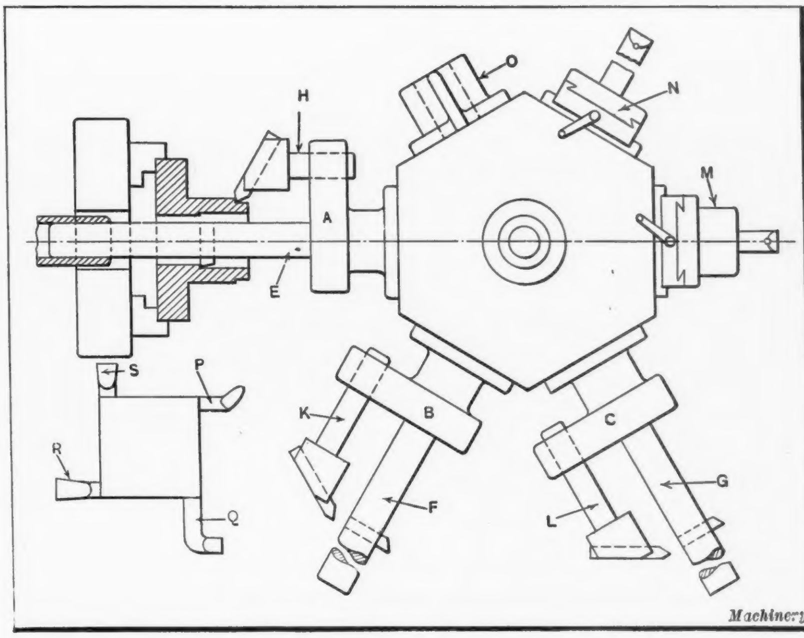


Fig. 2. Turret Lathe Tooling Equipment which provides for handling a Large Range of Chuck Work

After these cuts are taken on all parts of the lot, the chuck is provided with a set of soft jaws, as shown in Fig. 3, to suit the second operation. In the first step of this operation, the work is again bored by a tool in boring-bar *E*, and the periphery of the flange is turned by the tool in holder *H*, these tools, of course, having been adjusted prior to this step. At the same time tool *P* on the cross-slide turret rough-faces the flange.

Then in the second and final step on the part, the hole is finish-bored by the tool in boring-bar *F*, the flange periphery finish-turned by the tool in holder *K*, and the flange finish-faced by tool *Q* on the cross-slide turret. It might be possible to dispense with boring the hole in this operation, because extreme accuracy of the hole is not required. In that event the tool could be removed from boring-bar *F* and the bar used simply as a pilot to give additional stiffness to the set-up and thus insure the accuracy of the turned diameter.

In machining forging *B*, Fig. 1, it will be found more profitable to rough-drill the hole prior to the turret lathe operation. However, if it is desired to produce the rough hole while the work is mounted in the turret lathe, a drill may be inserted in holder *O*, Fig. 2, for the purpose. Assuming that the hole has been drilled in a previous operation, the work is held in the chuck by the same set of standard jaws as is shown in Fig. 2. Before the first operation on the part, as shown in the upper part of Fig. 4, the turning tool-holder is removed from head *A*, although it would be possible to employ this tool for turning off some of the stock on the cylindrical surface of the work. In this case less stock would need to be removed later.

First Operation on Part B

In this step the hole is bored by the tool in boring-bar *E*, tool *P* on the cross-slide turret being utilized at the same

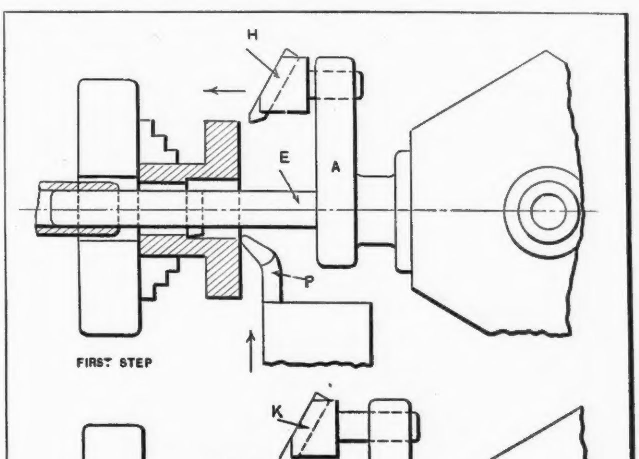


Fig. 3. Two Steps in the Final Machining Operations on the Part shown at A in Fig. 1

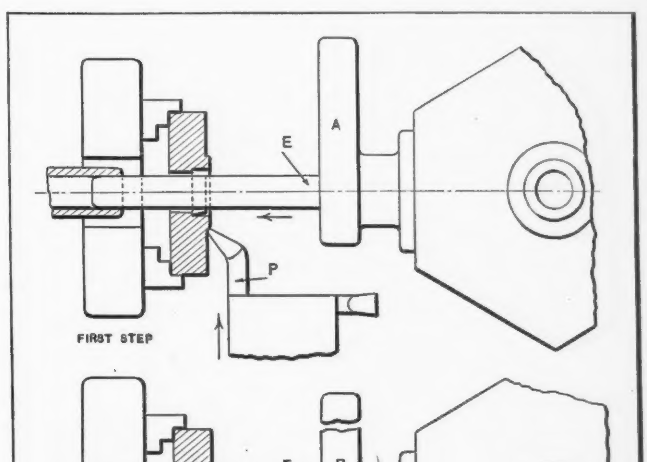


Fig. 4. Rough- and finish-boring the Hole of Part B, Fig. 1, and facing One Side

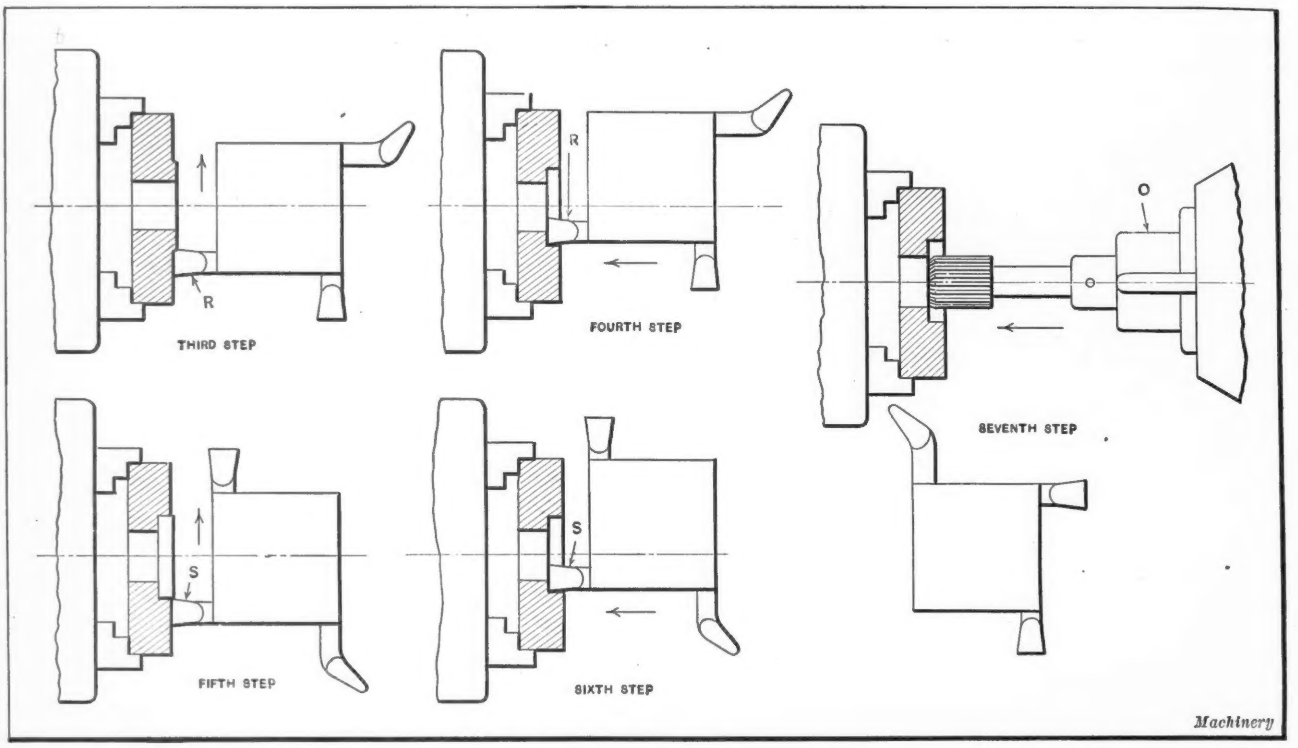


Fig. 5. Four Facing and Recessing Steps in which Tools on the Cross-slide Turret are employed, and a Final Reaming Step accomplished by Means of a Reamer on the Hexagon Turret

time for removing the scale on the face of the forging. In the second step, the hole is finish-bored by the tool in boring-bar *F*. As the facing cut in the first of these steps is somewhat longer than the boring cut, the tool in boring-bar *E* may be fed partly through the work before the facing cut has been completed. By using a somewhat coarser feed for the cross-slide than for the hexagon turret, both rough-boring and rough-facing cuts could be completed at approximately the same time. Such a procedure would permit the second boring step to be taken at a faster rate of feed than the first boring operation as the cross-slide turret tool would not need to be taken into consideration.

For the third step, the hexagon turret is moved away from the work and the cross-slide turret tool *R* is used for facing the part, as shown in Fig. 5. By setting this tool in such a manner that the heel drags slightly across the work and removing only a small amount of stock, a coarse feed may be employed, thus reducing the time of the cut.

In the fourth step, the pocket or recess is roughed out by means of tool *R*. Two methods of feeding the tool are possible in removing the stock from this pocket; the cross-slide may be fed longitudinally, or the tool may be started at the edge of the smaller hole and fed radially outward, as indicated by the arrows. Whichever method is used,

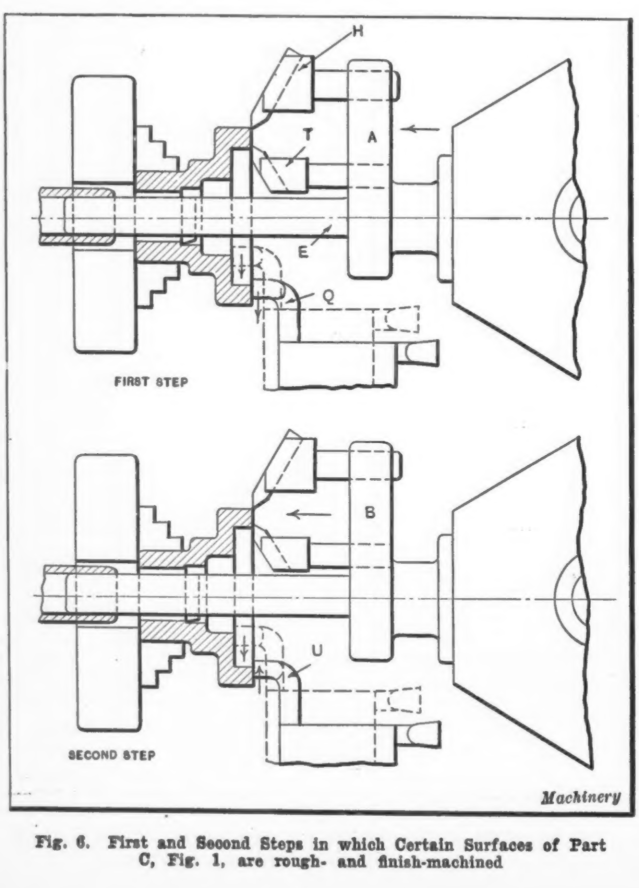


Fig. 6. First and Second Steps in which Certain Surfaces of Part C, Fig. 1, are rough- and finish-machined

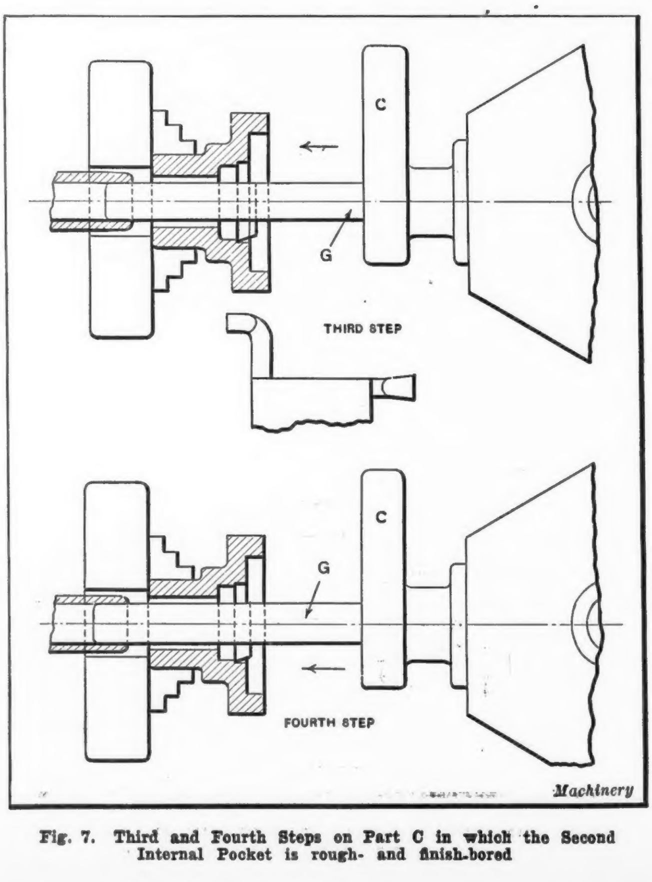


Fig. 7. Third and Fourth Steps on Part C in which the Second Internal Pocket is rough- and finish-bored

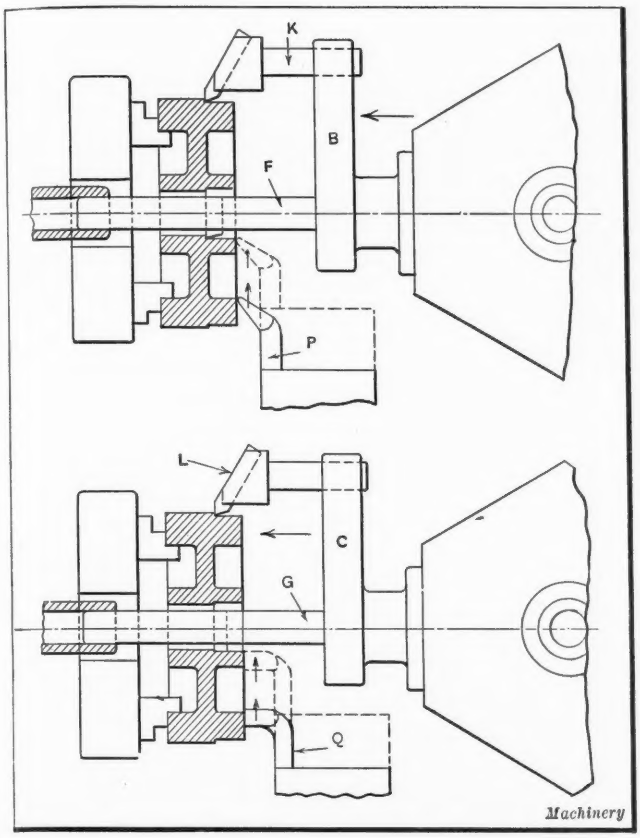


Fig. 8. Rough and Finish Turning, Facing and Boring Steps on a Flywheel Pulley

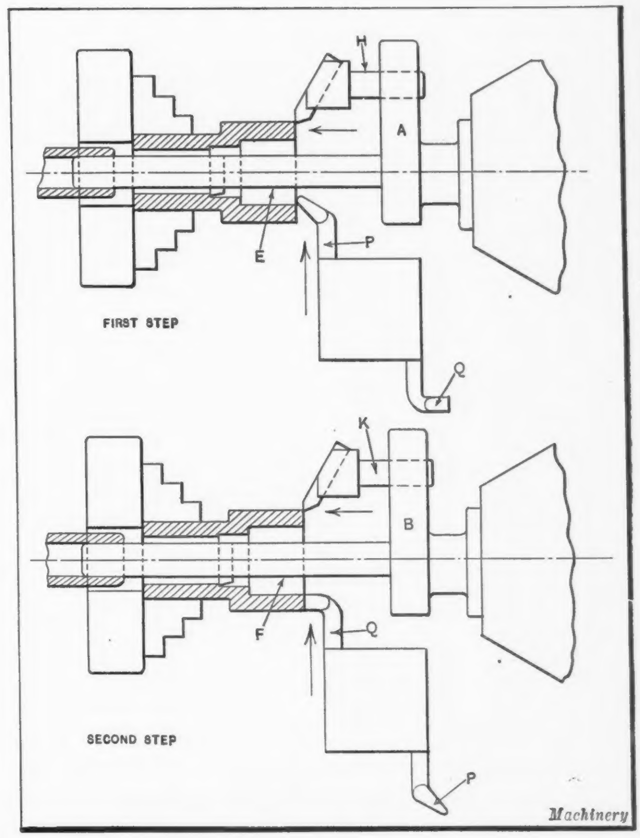


Fig. 9. Preliminary Steps on a Steel Billet, in which the Piece is rough- and finish-turned, faced, and bored

the final sizing of the shoulder should be accomplished by moving the cross-slide longitudinally because greater accuracy can be obtained in this way. If a tool of this type is fed longitudinally against the work, when much stock is removed considerable chatter is likely to develop. However, this depends on the way in which the tool is ground, the rate of feed, and the quality of the material.

Fifth, Sixth, and Seventh Operations on Part B

In the fifth step on part *B*, a final finishing cut is taken across the face of the work by tool *S* on the cross-slide turret; however, it may be possible to eliminate this step. The sixth step consists of finishing and sizing the recess with tool *S*. The cross-slide is first set by a micrometer dial so that the tool will cut to the proper diameter, after which the operator feeds it longitudinally until the desired depth has been reached. The dial permits an accurate setting so that the work can be produced within the required limits of accuracy without difficulty. If concentricity between the small hole and the recess wall is essential, and the diameter of the small hole is held within close limits of accuracy, it is advisable to ream the hole in a seventh step by using a

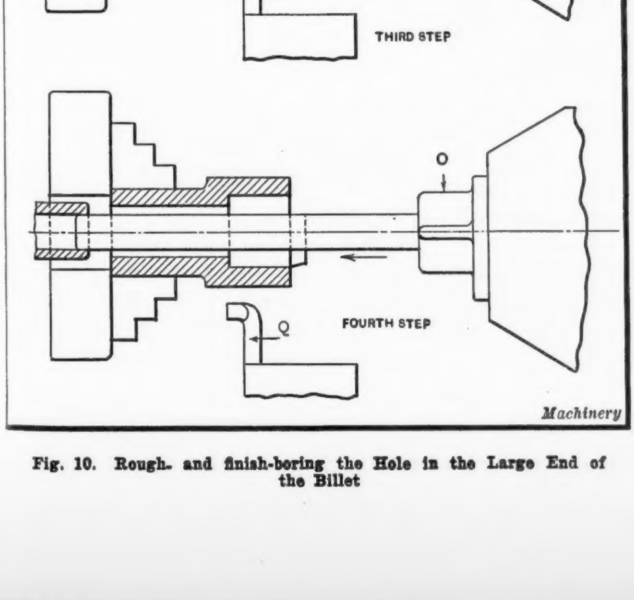


Fig. 10. Rough- and finish-boring the Hole in the Large End of the Billet

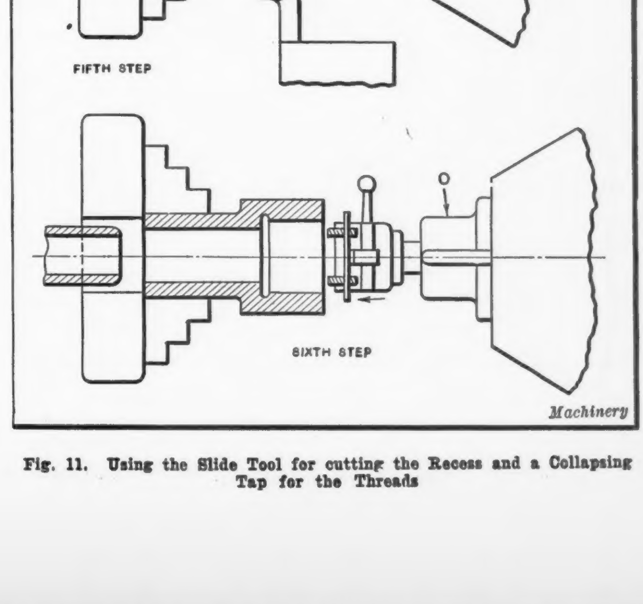


Fig. 11. Using the Slide Tool for cutting the Recess and a Collapsing Tap for the Threads

reamer in holder *O*. It would also be possible to bore the hole once more and obtain very close results.

If it seems desirable to use a reamer, holder *O* should be supplied with a suitable floating holder which will permit the reamer to follow the hole generated by the boring tools in the first steps on this part. When only half a dozen pieces are to be made and no suitable reamer or floating holder is available, it would probably be more economical to finish the hole by boring rather than by reaming. Concentricity of the outside cylindrical surface can best be obtained in an engine lathe with the work mounted on an arbor.

Finishing Steel Casting C

Several additions to the set-up of the hexagon turret tools are necessary to provide for machining casting *C*, Fig. 1, and one of the tools on the cross-slide turret must be replaced. The equipment used for the first two steps is shown in Fig. 6. The work is held by the jaws used for holding the part in the set-up illustrated in Fig. 3, the face of the chuck acting as a stop for the end of the casting. Thus each piece projects the same distance beyond the front of the jaws. Boring-bar *E*, Fig. 6, in facing head *A* is used for boring the hole. In conjunction with this bar, the tool in holder *H* is utilized for turning the rim of the flange, and another tool in the extra holder *T*, on head *A*, bores the inside of the rim.

The cross-slide turret tool *Q* rough-faces the first internal shoulder, the tool being brought against the work, as indicated by the dotted lines and fed radially outward. The flange is then rough-faced by the same tool, its position being determined by the longitudinal stops on the cross-slide. The next step consists of taking finishing cuts on all surfaces rough-machined in the step just completed. These cuts are taken by tools mounted on facing head *B* and by tool *U* on the cross-slide turret, which has been temporarily substituted for tool *R*, Fig. 2. In the third step, which is illustrated in Fig. 7, the second pocket in the work is rough-bored by a tool in boring-bar *G*. The cross-slide remains idle during this step.

Prior to the fourth step, the cutter in boring-bar *G* is adjusted to a simple gage, and then once more employed for boring this pocket. This step could also be performed by using another boring-bar in holder *O*, Fig. 2. The latter method is preferable, as there are always possibilities of error in setting the same boring-bar to cut two different diameters. This is a good example of the facility with which certain work can be machined in small lots on a turret lathe provided with standard equipment. Castings of the type shown are common in general manufacturing work.

Tooling for a Flywheel Pulley

Only two steps are required in machining the flywheel pulley *D*, Fig. 1, the part being held for these steps by chuck jaws which grip the inside of the rim, as shown in Fig. 8. The tool in holder *K* is employed for turning the outside of the pulley rim, and the tool in boring-bar *F* is used for rough-boring the hole. At the same time tool *P* on the cross-slide turret is utilized for facing one side of the rim and one end of the hub.

The second step on this piece consists of finish-turning the pulley rim with the tool in holder *L* mounted in facing head *C*, and finish-boring the hole with the tool in boring-bar *G*. At the same time the cross-slide turret tool *Q* is used to finish-face the rim and hub surfaces that were rough-faced in the preceding step. The machining of the remaining surfaces of this part on which finish is specified can be readily accomplished with the same equipment by substituting a set of soft jaws for those illustrated to hold the

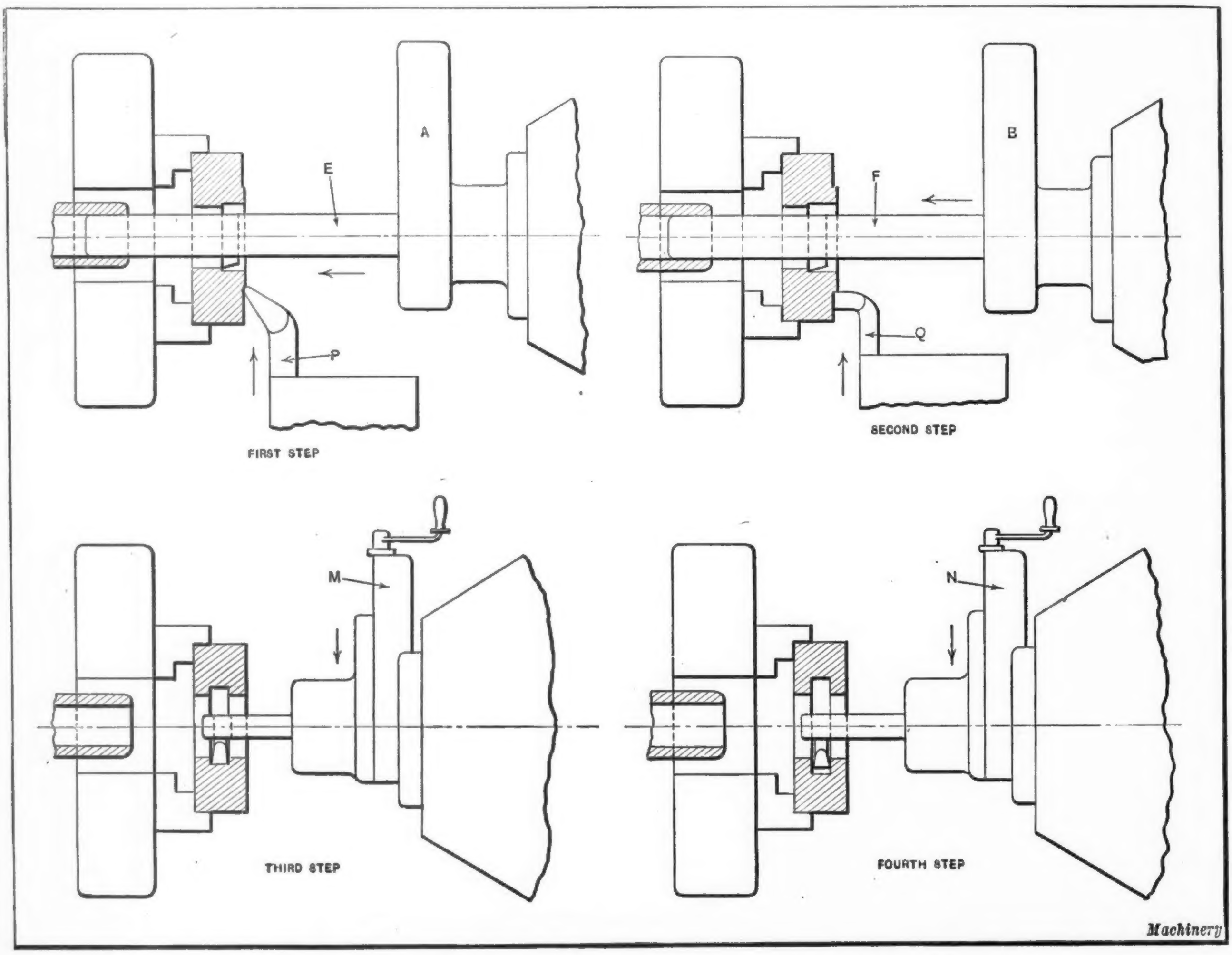


Fig. 12. Succession of Steps employed in machining a Bronze Retaining Collar

work by the finished rim, and employing tools *P* and *Q* successively, for rough- and finish-facing the opposite sides of the rim and the hub.

Finishing a Steel Billet All Over

As previously mentioned, example *E*, Fig. 1, is machined from a solid steel billet. Before bringing this part to the turret lathe, it is preferable to rough-drill the hole through the center. This work, of course, could be done on the turret lathe, but it will be assumed that the hole is produced previously. As shown in Fig. 9, the work is gripped on the shank by standard chuck jaws. In the first step on this part, the cylindrical surface of the large end is rough-turned by the tool in holder *H*, the hole is rough-bored by the tool in boring-bar *E*, and the end of the work is rough-faced by tool *P* on the cross-slide turret, these three tools being employed simultaneously.

The next step on the piece consists of taking finishing cuts over the same surfaces, the tools in facing head *B*, and tool *Q* on the cross-slide turret being used. In the third step, illustrated in Fig. 10, the hole in the large end of the forging is rough-bored by the tool in boring-bar *G*. It is, of course, necessary to provide the bar with a longer tool than has been required up to this time. As the cross-slide is idle during this step, it is moved out of the way so as not to interfere with the movements of the hexagon turret. The finish-boring of this hole is accomplished in the fourth step by another boring-bar in holder *O*. The use of this additional boring-bar enables the necessary setting to be quickly obtained.

The recess at the internal shoulder of the forging is machined in the fifth step by the use of slide tool *M*, as illustrated in Fig. 11. A suitable bar provided with a tool is used on the slide for this purpose. In performing this step, the cutting tool is advanced until its front edge comes in line with the shoulder of the work previously machined. Then the tool is fed down until the proper reading is obtained on the dial of the slide. The final operation on this piece consists of cutting the internal thread, and for this step a collapsing tap is inserted in holder *O*. This arrangement might be inadvisable if chasers and a collapsing tap of the correct size are not found in the tool-crib. It would then be necessary to chase the thread in an engine lathe while the work is mounted on an arbor, or a chasing attachment could be applied to the turret lathe for chasing the thread before the work is removed from the chuck.

Finishing Bronze Collar F

The four steps for finishing the bronze collar *F*, Fig. 1, are illustrated in Fig. 12. This piece is held in the usual manner by chuck jaws which grip the work at points along its periphery. The first step consists of boring the hole with the tool in boring-bar *E*, and rough-facing one side of the work with tool *P* on the cross-slide turret. It would be an easy matter during this step to turn a portion of the periphery with a tool held in a holder inserted in one of the holes of facing head *A*, and it might be advisable to do so in order to remove the scale on this surface and thus permit some of the other machining operations to be more readily performed.

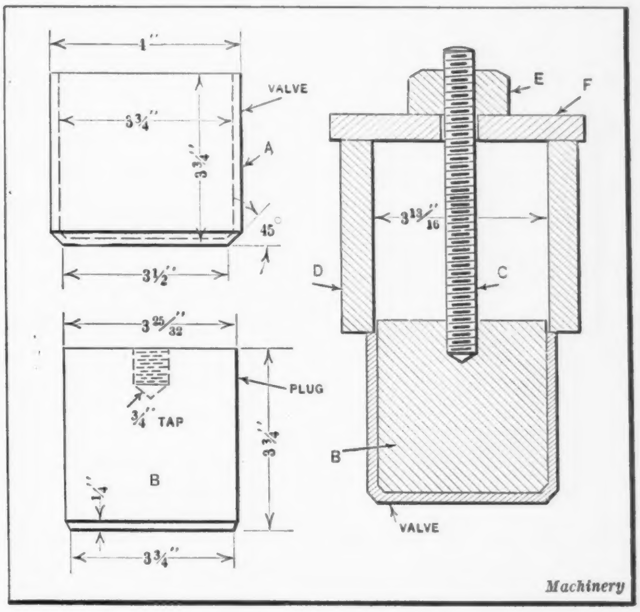
In the second step the hole is finish-bored by the tool in boring-bar *F*, and finish-faced by tool *Q* on the cross-slide turret. The third step consists of cutting the internal recess by means of a suitable cutter on slide tool *M*. This slide is, of course, fed vertically downward, as indicated by the arrow, until the recess has been machined to the desired diameter, as indicated by the dial on the slide. The recess is finished in the fourth step by a similar cutter to that used in the roughing step, mounted on slide tool *N*. The remaining work consists of facing the opposite side, and turning and threading the periphery. This can best be done in an engine lathe, with the work held on an arbor.

SALVAGING AIR COMPRESSOR VALVES

By STANLEY P. GOULD

The salvaging process described in the following was employed recently in restoring a lot of steel air compressor valves to useful service. The compressor valves, one of which is shown at *A* in the illustration, had become worn to such an extent that they had from 1/64 to 1/32 inch play in their bronze cages. The outside diameter of the valves was 4 inches, and the inside diameter 3¾ inches, as shown. Formerly the bronze cages were rebored and new steel valves made to fit the rebored cages, but this involved considerable expense, as the valves were cut from solid bar stock.

With the new method the old valves were first annealed by heating with a gas torch to a red heat, after which they were allowed to cool slowly. A steel plug *B* was then made to the dimensions shown in the illustration. This plug was lubricated with oil and white lead and forced into the open end of the valve by means of a screw press, thus ex-



Air Compressor Valve and Expanding Plug

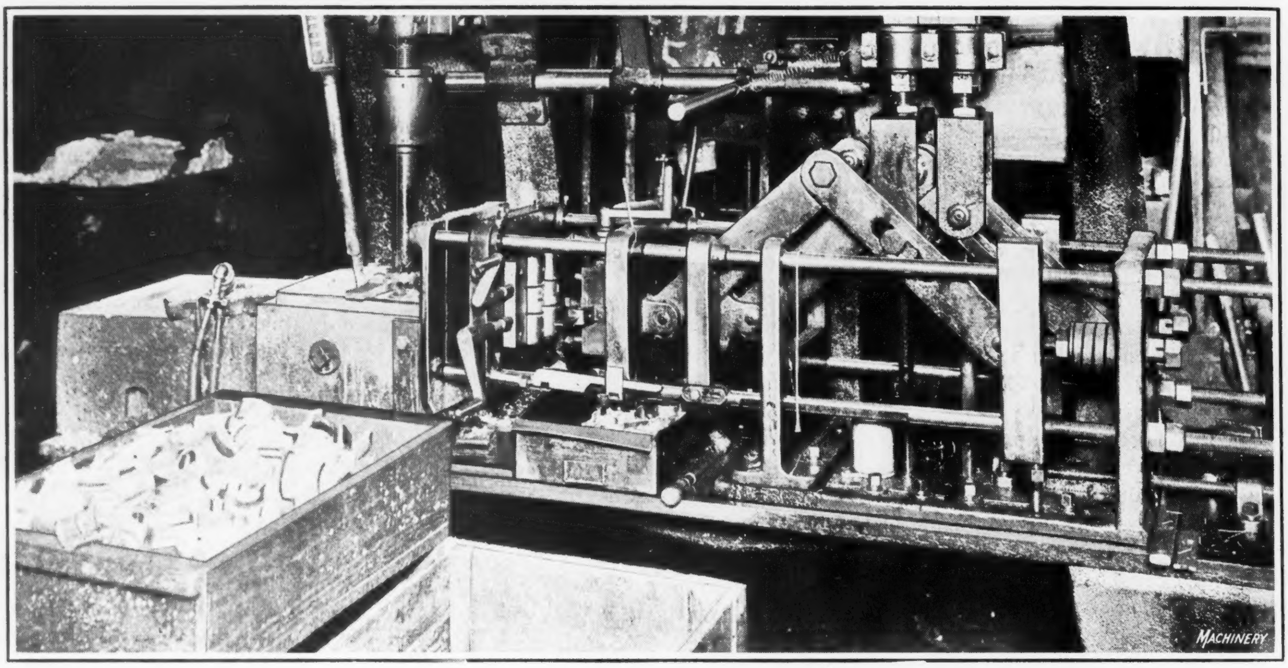
panding the valve sufficiently to increase its outside diameter 1/32 inch. The plug was then removed from the valve by means of a stud *C* and a sleeve *D* arranged as shown in the view at the right-hand side of the illustration. By tightening the nut *E* against the strap *F*, plug *B* is withdrawn from the valve.

The solid end of the valve was next cleaned and tinned, after which a 1-inch square nut was soldered to the tinned end to enable the valve to be held in a four-jawed lathe chuck. The valve seat was then faced off at an angle of 45 degrees and the outside of the cylindrical part turned. Next the square nut was removed from the end of the valve by heating sufficiently to melt the solder, and the bronze cages were bored to fit the valves. Out of a total of forty-eight valves repaired in this way only four were split in forcing the plug in with the press. The repaired valves are now operating as well as new ones, and the saving in labor and material by making repairs as described was substantial.

* * *

In the first ten months of 1922, the railroads of the United States ordered over 117,000 freight cars. During the same time, 866 locomotives were put in service, and in addition, orders were placed for 1232, making a total of over 2000 locomotives placed in service or ordered. In 1921, the number of freight cars ordered was less than 70,000, and the total number of locomotives placed in service or ordered was 1382.

Dies for Die-castings



Specific Examples of the Design and Construction of Dies for Making Die-castings of the More Intricate Types—Third of a Series of Articles

By A. G. CARMAN, Chief Metallurgist, Franklin Die-Casting Corporation, Syracuse, N. Y.

In the January installment of this series of articles, methods of designing dies for wheels having raised letters or figures on their periphery and for instrument housings were illustrated and described. The present article will describe dies for aluminum venturi tubes used in gas engine mixing chambers, dies for push-button stem guides and dies for door checks. A later article will deal with the metals used for making die-castings.

Die for Venturi Tubes

The first die to be considered will be that used in producing an aluminum venturi tube. The upper part of the die is shown at the left in Fig. 1, and the lower part at the right in this illustration, with the aluminum casting just below. Cores *A*, *B* and *E* are operated and locked in position by toggle levers, while cores *C* and *D* are operated by rack levers *F* which are actuated by pinions *G*. The four dowel pins shown serve to align the two parts of the die. On the lower plate is an opening *J* through which metal is admitted into the die.

A detailed view of the casting is shown in the lower right-hand corner of Fig. 2; this illustration also shows an assembly view of the die for the venturi tube at the left, and views of the various cores in the upper right-hand corner. The heavy dark line in the elevation of the assembled die represents the parting line of the die. In this particular example, the parting line is very irregular, projecting deeply into the upper plate and thereby making it possible to operate cores *C* and *D* through rigid blocks of steel.

The cores *C* and *D* meet when they are locked in place, and form a continuous opening through the casting, tapering in both directions from the center. Each of the rack levers shown at *F* carry, in addition to cores *C* and *D*, two small cores which form the bolt holes in the flanges on the ends of the casting. The casting is removed from the die by two ejector-pins *L*. Care must be taken to see that the ejector-pins are not left projecting into the die after the casting has been removed, for if the cores should be moved back into position before the ejector-pins have been withdrawn, both the ejector-pins and the cores might be damaged.

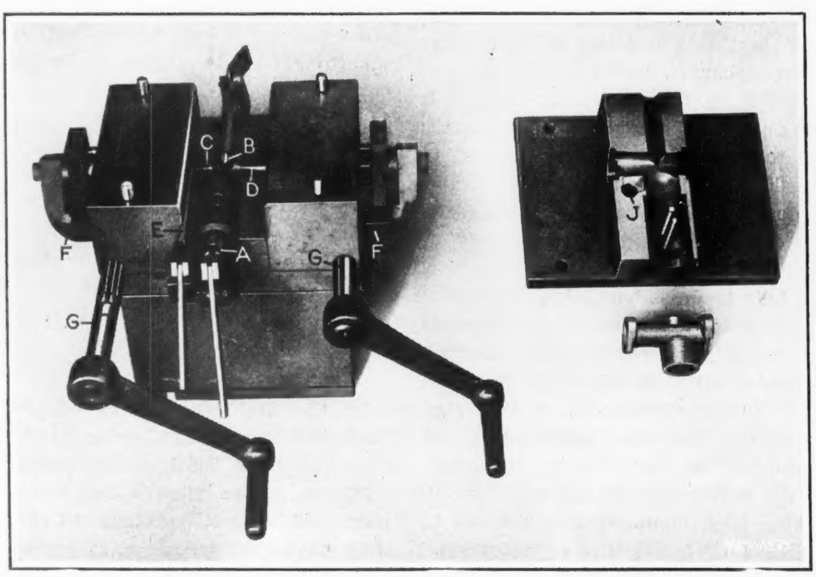


Fig. 1. Die for producing an Aluminum-base Venturi Tube for a Gas Engine Mixing Chamber

Plan and elevation views of a die used in producing an

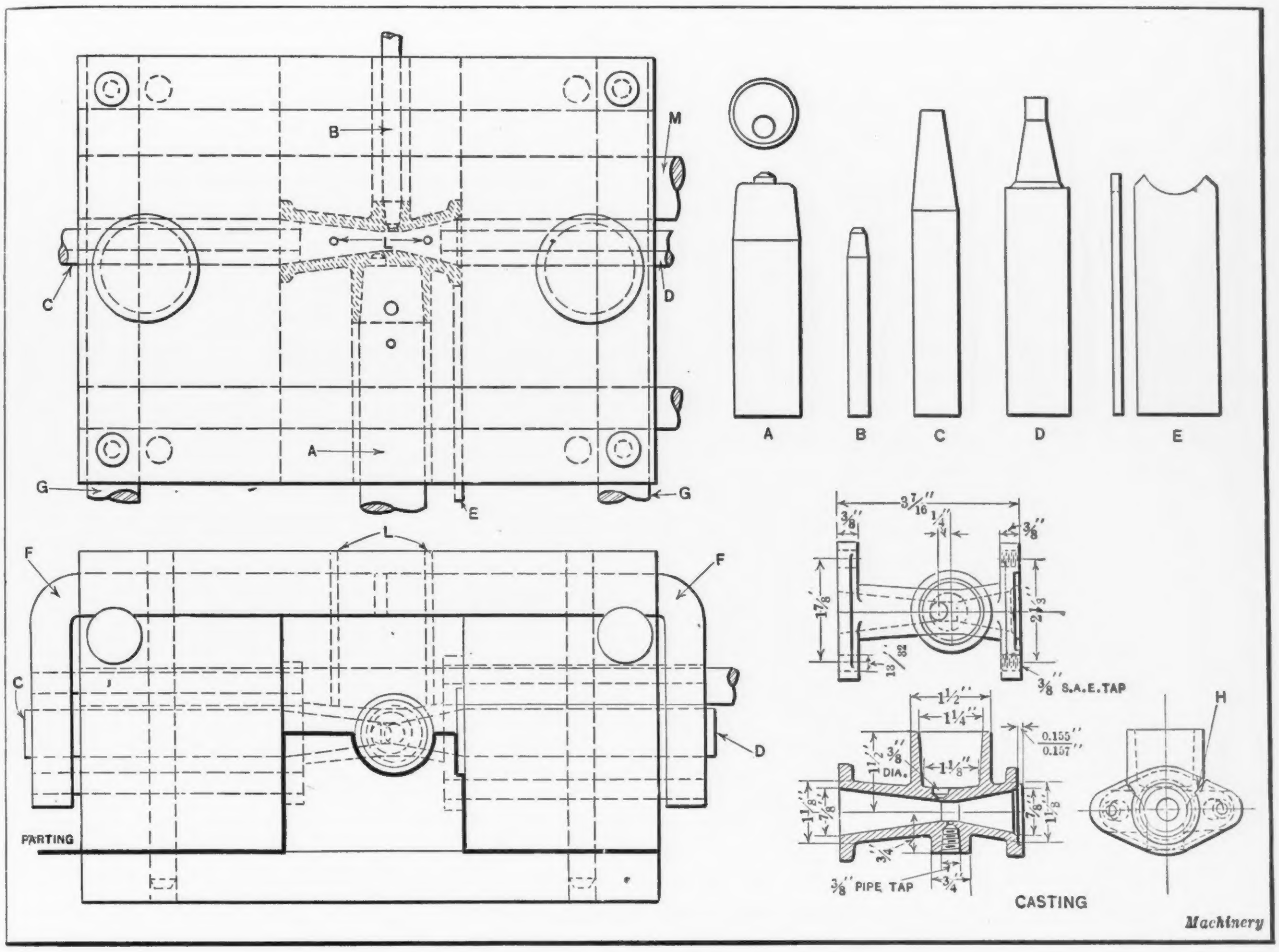


Fig. 2. Detail Views of Cores, Die, and Casting illustrated in Fig. 1

accelerator push-button stem guide for an automobile are shown in Fig. 4, together with a detail view of the aluminum casting. A special feature of this casting is that it has a steel insert 2 9/16 inches long and $\frac{3}{8}$ inch in diameter. The portion of the insert that is surrounded by the metal is previously indented in a punch press so as to allow the cast metal to obtain a grip on it, and prevent any possibility of the insert becoming loose. Two castings are produced in this die at the same time. The parting of the die, as indicated by the dark line, follows the shape of the casting, and at the right of the casting, cuts deeply into the upper plate. This construction gives more room in the lower plate to serve as a bearing or sleeve for the two large cores *C* which produce the round central hole and the three countersunk holes in the base of the casting. Both cores *C* are operated by pinion *D* which engages racks on the cores.

Before the die is closed, preparatory to making the casting, the round steel inserts are placed in holes *B* in the upper plate of the die, a portion of the insert equal to the length of the casting boss being allowed to project into the casting depression. It is important that the inserts be of the correct length. If too short, they will not extend all the way through the casting and, on the other hand, if too long, they will prevent the die from closing properly and allow metal to be forced out of the die at the parting line.

The part of cores *C* that produces the long central hole passes through the casting depression and into the upper plate of the die; this makes it necessary to withdraw the core slightly before opening or closing the die so that the cores will not be damaged. In order to support the casting properly while removing the core, the die is so designed that the base of the casting does not rest on the face of the core, but on slotted sections *E* in both halves of the die. Holes through the thin support of the slotted sections receive the central core and the smaller cores which form the three countersunk holes in the base. The provision of blocks *E*, shown in detail in the upper right-hand corner, simplified the machining of the recess for the base of the casting. The ejector-pins are shown at *G*. One pin acts directly on the steel insert and the other two pins act on the lower part of the casting, as shown.

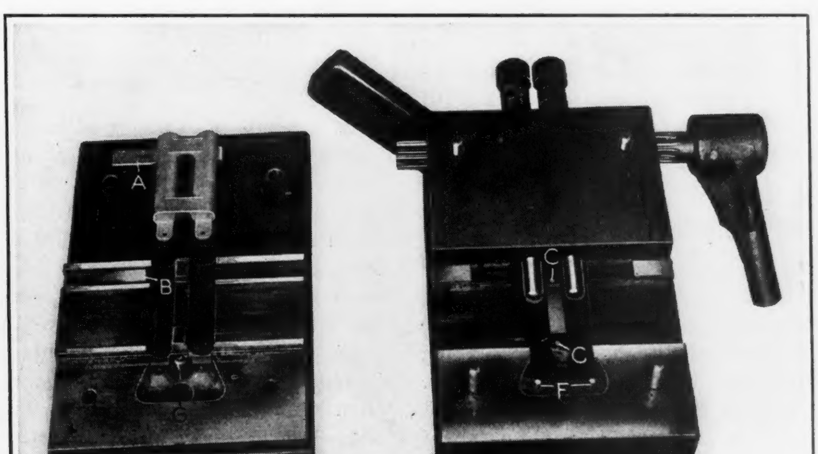


Fig. 3. Die used for casting Aluminum Door Checks

Automobile Door-check Die

A die for making an aluminum door-check for an automobile is shown in Fig. 3. This casting has walls about 1/8 inch thick, and air chambers about 4 inches long for leather plungers. One of the requirements is that the inner walls must not leak under an air pressure of from 30 to 40 pounds per square inch. These castings are made right- and left-hand, the only difference in the two types being in the position of lug *A*. This position is determined by the location in the die of a small steel piece *B* which is a duplicate of lug *A*. Piece *B* may be fastened first in one side of the die and then in the other by means of dowel-pins, for producing the right- and left-hand castings. This change permits both castings to be made in the same die. The metal is introduced through the opening *G*. The two ejector-pins

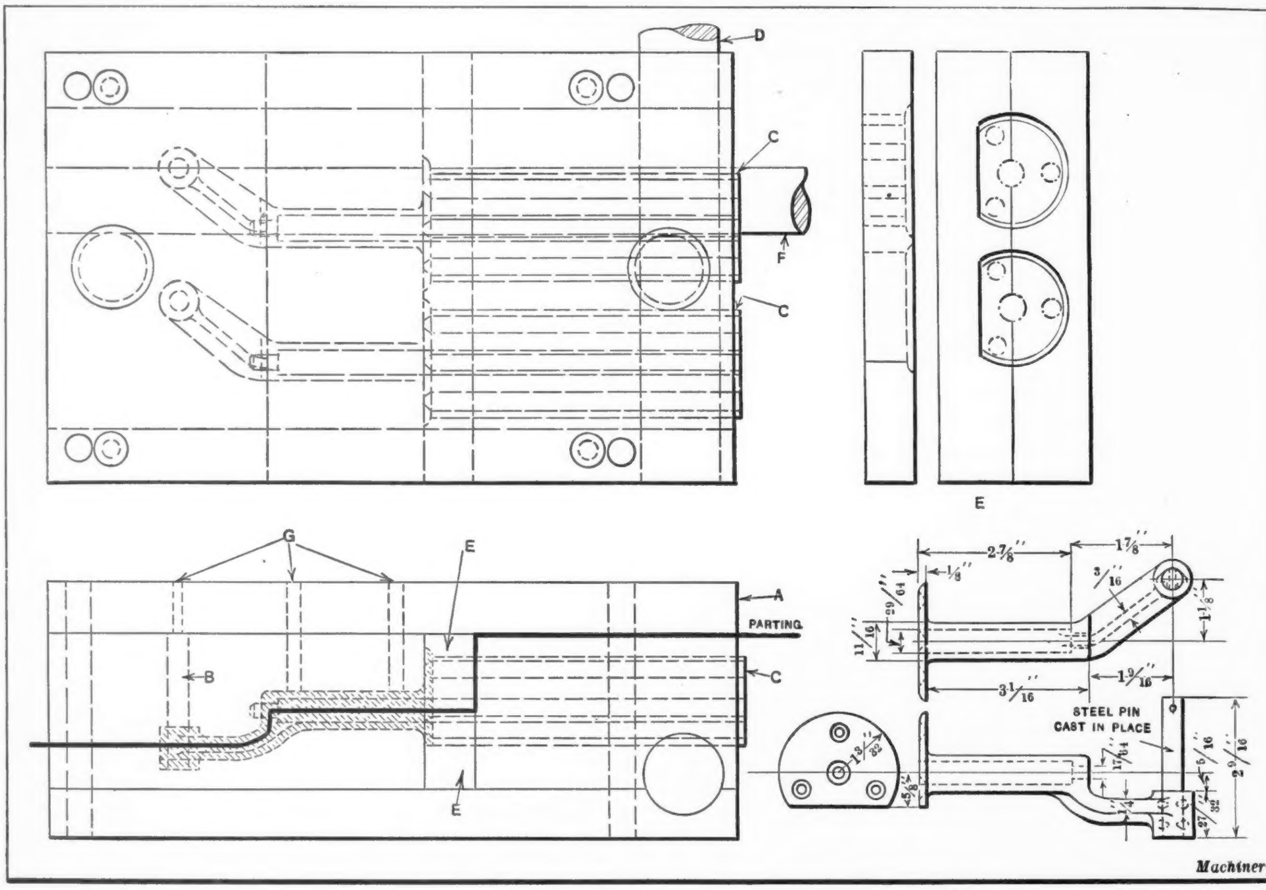


Fig. 4. Detail Views of Die for Push-button Stem Guide, and Aluminum Casting produced in it

C are fastened to the ejector-box *D* which is operated by pinion *E*. Two additional ejector-pins *F* which are also fastened to ejector-box *D*, prevent the metal in the gate from producing a strain on the two slender ears at the end of the castings.

* * *

INVESTIGATIONS BY THE BUREAU OF MINES

There has been a great deal of secrecy surrounding the use of titanium as an alloying element for steel. According to the Bureau of Mines, Washington, D. C., carbon-free ferro-titanium has been employed in Europe for making an electric steel containing from 5 to 7 per cent titanium. It has been stated that titanium alloy steels have been used for armor plates, but so far as is known to the Bureau of Mines, no merit has been found in the addition of titanium to steel as an alloying element, and experiments with steels containing from 0.1 to 1 per cent titanium have not proved this alloy steel to have any exceptional qualities. It is believed that a more thorough investigation than any so far carried out is required to determine more clearly the qualities of titanium alloy steels, and the Bureau of Mines assumes that, pending more exact proof to the contrary, these steels are of no unusual value, or at least have no advantages not already provided by other steels. It is possible, however, that some percentages of titanium, either alone or with other metals, might produce valuable qualities in steels for certain purposes, and more complete experiments need to be carried out; titanium increases the hardness of steel, and further experiments with titanium alloy steels should certainly not be discouraged.

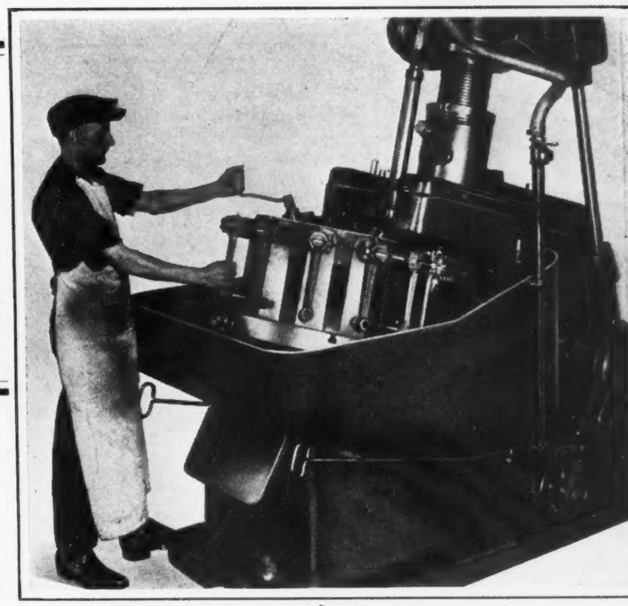
Titanium is used, however, to a considerable extent as a final deoxidizer and denitrogenizer in the making of steel. It has been used for this purpose for a number of years in the production of Bessemer rail steel, and is also used as a scavenging agent for many other kinds of steel, including sheet steel; about 2,500,000 tons of sheet steel are treated with ferro-titanium alloys in the United States annually.

Electric Furnaces for Brass Melting

As a result of a study of brass furnace practice in the United States, the Bureau of Mines declares that if electric furnaces were completely substituted for crucible and oil-fired furnaces in the brass-melting industries, the savings would amount to from $2,000,000 to $3,000,000 a year. The Bureau further estimates that if all the brass made in the country in 1917 and 1918 had been electrically melted, the cost could have been reduced by $10,000,000 each year. One of the great losses in the manufacture of brass in the old type of furnace is stated to be the loss of zinc through vaporization, possibly as much as 6 per cent of the zinc being lost in making brass castings, and as much as 10 per cent in making wrought brass. The investigations of the Bureau of Mines are recorded in considerable detail in Bulletin 202, "Electric Brass Furnace Practice," copies of which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the price of 50 cents.

Milling Automobile Connecting-rods

By CHARLES LITTELMANN
Supervisor of Service, Oesterlein Machine Co., Cincinnati, Ohio



A ONE-PIECE connecting-rod, as distinguished from a two-piece rod, is one in which the connecting-rod and its bearing cap are forged in one piece, and the holes bored or broached, after which the cap is sawed from the rod. The first machining operation on a one-piece rod is usually the straddle-milling of the crankshaft and wrist-pin bosses.

A fixture used in performing this operation on the Ohio tilted rotary milling machine is shown in Fig. 1. This is a three-station fixture with three work-holding divisions. While the work is being machined at one station the operator is loading at another station. It is possible to use a fixture with only two stations for this operation, the third station being provided merely to give the operator more leeway in loading the fixture. The cycle of operations is automatic: The table indexes; then the ram feeds the cutters forward into the work, and drops back rapidly at the end of the cut for the next indexing of the table. The entire time consumed in making the cycle is available for the operator to unload and load the fixture.

Handling the Work on a "Two-story" Fixture

The length of the wrist-pin boss is usually less than the length of the crankshaft bearing. For a rod of this design, the fixture used is essentially a "two-story" fixture, each station of which consists of an indexing plate arranged to hold two rods placed end to end. The arbor carries two sets of cutters, the lower set for straddle-milling the wrist-pin boss, and the upper set for performing a similar operation on the crankshaft boss. In one cycle of operations the opposite bosses of two rough forgings are machined, and when the first station reaches the loading position, the operator indexes the fixture plate so as to bring the opposite bosses into the cutting position. When this station again reaches the loading position both rods are finished and removed.

It will be seen that two bosses, or the equivalent of one rod, are completed at each cycle. These cycles are timed in seconds, and vary with the size of the rods and the hardness of the steel from which they are made. The time required for the cycles varies from 40 seconds, which gives a production of ninety complete rods per hour, to 30 seconds, which gives a production of one hundred and twenty rods per hour. In practice, it was found to be a better division of the operator's time to arrange the two rods in each indexing plate so that one would be receiving the second cut while the other was being milled for the first time. By this arrangement the operator would index the work-holding plate and remove one rod at each cycle, instead of removing two rods every other cycle. For this reason, the clamping of each rod is independent. An automatic trip for the index-plunger makes it unnecessary for the workman to operate the plunger by hand when indexing the work-holding plates.

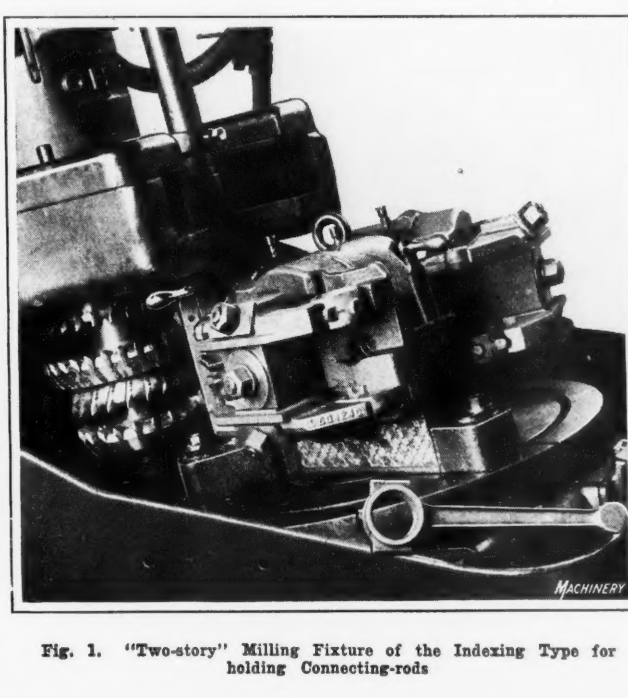


Fig. 1. "Two-story" Milling Fixture of the Indexing Type for holding Connecting-rods

Power Requirements

The power used per 40-second cycle is shown graphically by the curve in Fig. 2. This curve was recorded on the tape of an Esterline graphic wattmeter. The chart shows the wattmeter record during four cycles of the machine. In the operation of the meter, the recording tape feeds past the swinging recording pin in the direction of the arrow, so that the sequence of events is read from right to left.

As previously explained, the rods are clamped in a two-story fixture, and when the cut is taken a crankshaft boss is located on the upper story and a wrist-pin boss on the lower story. When the advancing cutters meet the crankshaft boss, the peak A is registered by the wattmeter pointer. The relation of bosses and cutters at different stages in the cycle is shown in Fig. 3. The cutters meet a comparatively broad cutting surface at A, and the power consumption mounts sharply as shown by the curve at A, Fig. 2.

As the cutters advance, they pass off the wide cut and are then cutting only on two narrow areas, as shown at B, Fig. 3. The result is a decrease in power to the point B on the curve, Fig. 2. As the cutters continue to feed in, the lower set of cutters begins to mill the wrist-pin boss, as indicated at C, Fig. 2. This load is in addition to the light load indicated at B. These cuts result in a jump in the power curve to the point C, and as the feed advances this power curve gradually rises until it reaches the peak D, at which time the lower cutters are still at work on the wrist-pin boss

(see diagram *D*, Fig. 3), and the upper cutters have met the broad cut on the opposite side of the crankshaft boss. It will be noted that peak *D* is higher than peak *A*, the difference in height representing the power required for the wrist-pin boss and the slightly broader cut on the crankshaft boss.

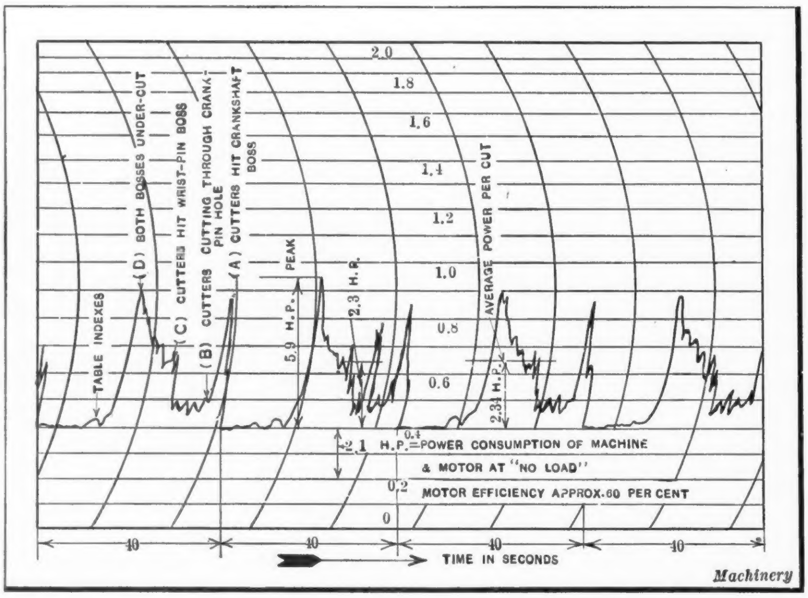


Fig. 2. Section of a Wattmeter Recording Tape, showing Consumption of Power in milling Crankshaft and Wrist-pin Bosses

Each horizontal line on the curve represents 0.8 kilowatt, or 800 watts. An eight-to-one step-down transformer was used in the motor circuit of the meter, so that one-eighth of the supplied current flowed through the wattmeter. For example, the peak *D* extends from the 0.4 kilowatt line to the 0.9 kilowatt line. The current flowing through the instrument was equal to the difference between these amounts, or 0.5 kilowatt. Eight times this current flowed through the motor, which was equivalent to $8 \times 0.5 = 4$ kilowatts, or 4000 watts. The horsepower consumption at peak *D* is therefore $4000 \div 746 = 5.4$ horsepower. The curves vary somewhat with the hardness of the stock from which the connecting-rod forgings are made.

When the curve shown was traced, the motor carried an additional load, so that the base line or "no load" line is at the 0.2 kilowatt line on the chart instead of at the zero line. The base line was determined by disconnecting the milling machine and recording only this additional load. The distance between the 0.2 and the 0.4 line represents the power consumption of the motor and the milling machine when the machine is running idle. This idle load is 1600 watts (2.1 horsepower), and as the motor efficiency is 60 per cent when carrying this load, the actual power consumption of the milling machine alone is 960 watts or slightly less than 1.3 horsepower.

Arrangement when Both Bosses are of Equal Length

When the crankshaft and wrist-pin bearings of a connecting-rod are of equal length, a simpler arrangement of the connecting-rods may be employed than is possible with a two-story fixture, as shown in Fig. 4. This illustration is a plan view of the fixture used, and shows the arrangement of the rods in pairs and their relation to the cutters during the milling operation. The cutters feed into the four bosses—two crankshaft and two wrist-pin bosses—the equivalent of two connecting-rods being thus completed at each cycle of the machine. This method gives a production of from 100 to 150 complete rods per hour. Only one set of cutters is required, since all bosses are of equal length and parallel. Carefully designed clamps are used for holding the connecting-rods so as to avoid clamping strains. With this method of milling the rods, the bosses may be held to tolerances of from 0.001 to 0.002 inch on the width and to within 0.005 inch of parallel.

Milling Bolt-hole Bosses and Cutting off Caps

After the rods have been broached and drilled, the bolt bosses are milled and the cap sawed from the rod, the fixture shown on the machine in the heading illustration being used for this purpose. In this case, a twelve-station fixture is shown, although fixtures that have as few as four stations may be used. The rods are placed on locating pins and are each held in place by a screw and horseshoe washer. The cutter-arbor carries two half side-mills and a saw located between them. The cutters are fed between two adjacent rods, milling two bolt bosses above and below, as well as cutting the adjacent sides of two caps at each cycle. The table indexes one-twelfth of a revolution, and during the next cycle the other side of one rod, and the first side of the adjoining rod are machined. The equivalent operations for one rod are therefore completed at each cycle of the machine. The production varies between 90 and 180 rods per hour, depending upon the width of the crankshaft bearing and the material from which it is made.

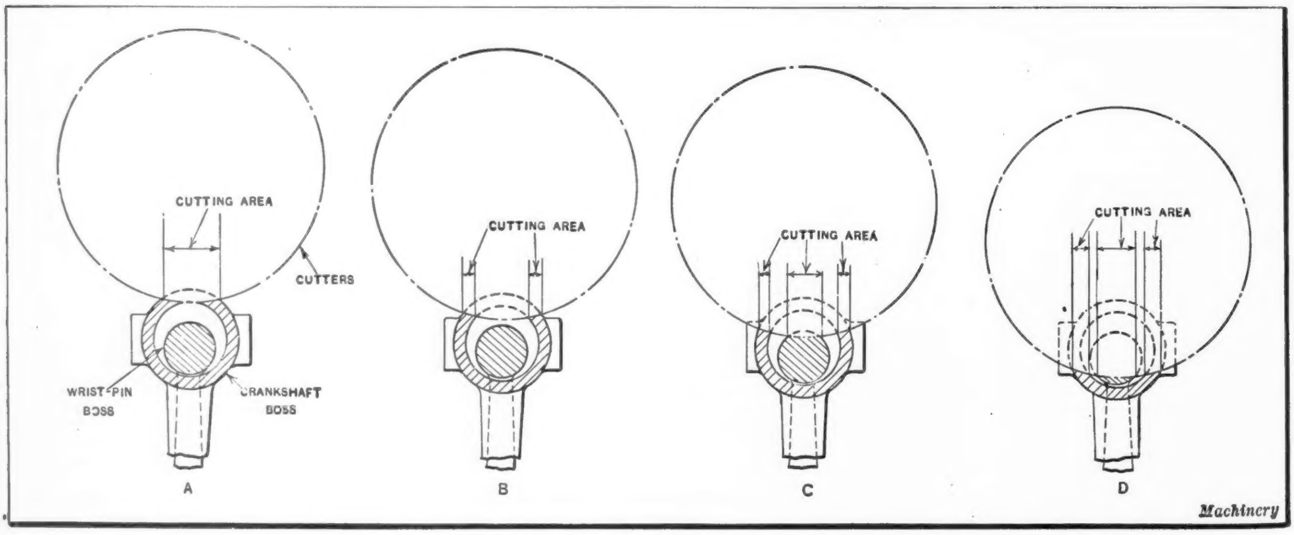


Fig. 3. Diagrams showing the Amount of Metal removed at Different Stages in milling One Crankshaft and One Wrist-pin Boss

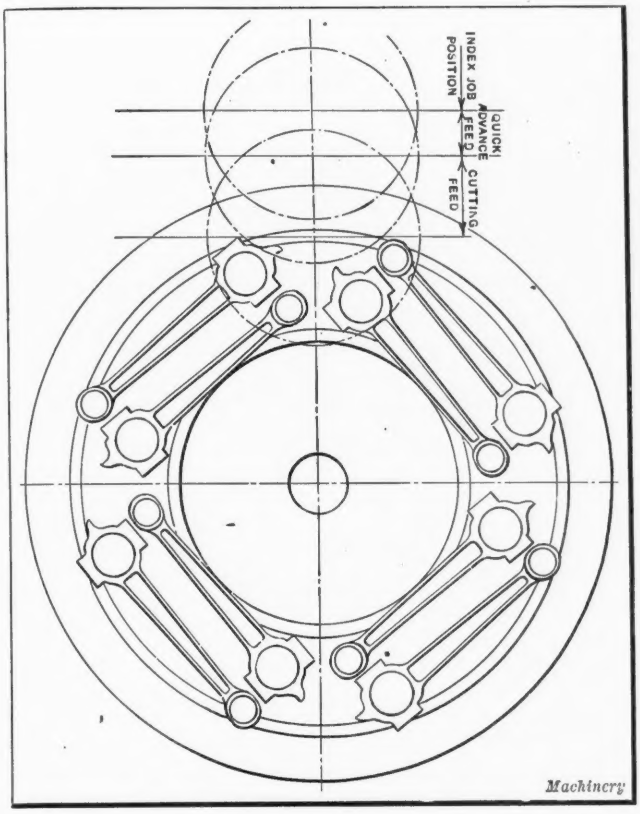


Fig. 4. Arrangement of Connecting-rods on a Station Milling Fixture when the Bosses at Opposite Ends are of the Same Width

TERMS OF PAYMENT FOR FOREIGN SALES

In the summary of an article on terms of payment for exported machinery, prepared by W. H. Rastall, chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce at Washington, it is stated that as far as industrial machinery is concerned, manufacturers should not take too seriously the reports coming from foreign countries intimating that more liberal terms should be granted in connection with export business. Experience indicates that neither European nor American manufacturers in this field grant exceptional terms in connection with the selling of machine tool equipment. This information, coming from the Department of Commerce, is of considerable value to American manufacturers, who have been told that in order to compete in Europe and other foreign countries they would have to grant more liberal terms of payment. Generally speaking, if the banks with whom the foreign buyer does business does not care to extend credit to him and thereby finance his purchases, there is no reason why the American manufacturer should act as banker. He has no facilities for knowing whether the risk is good or not, whereas the local bank generally does know. If the risk is not good enough for the customer's own bank, it is hardly good enough for an American manufacturer thousands of miles away.

* * *

Seventy-five per cent of the centrifugal pumps used in South Africa are of American manufacture. The duty on pumps is 3 per cent ad valorem, except on those imported from other parts of the British Empire, which are duty free; but the duty is so low that it does not offer a serious handicap to American manufacturers. There is an increase in the demand for wind mills in South Africa, which may offer an opportunity for American manufacturers in that field. Large pumps, such as are used in the mining industries, are mainly imported from England and Switzerland. Of the pumps imported for farm use, fully 90 per cent come from the United States.

FORMULAS FOR CONE PULLEY DESIGN

By LAURENCE T. FLEMING

In spite of the increase in multi-motored machine tools and the more common use of positive drives, it is hardly probable that belt-driven cone pulleys can be dispensed with for many years to come, particularly for feed drive purposes. The following formulas for determining directly the diameters of the steps of cone pulleys having any desired speed ratios, when the distance between centers and the diameters of any one pair of steps are known, may, therefore, be of interest to machine tool designers. In the formulas,

D = diameter of larger pulley plus thickness of belt, in inches;

d = diameter of smaller pulley plus thickness of belt, in inches;

C = distance between centers, in inches;

L = length of belt, in inches;

$m = \dfrac{D}{d}$ = speed ratio of pulleys.

By making use of the approximation that the sines of small angles vary directly as the angles, and by neglecting higher powers of the sine, which are so small in amount that they do not materially affect the result, the exact formula for the length of a straight belt may be reduced to the following form:

$$L = \pi \times \frac{D+d}{2} + 2C + \frac{(D-d)^2}{4C} \quad (1)$$

By substitution in Formula (1) we obtain Formula (2), which may be written,

$$d = \frac{\sqrt{[\pi C(m+1)]^2 + (4CL - 8C^2)(m-1)^2}}{(m-1)^2} - \frac{\pi C(m+1)}{(m-1)^2} \quad (2)$$

It will be noted that Formula (2) requires no intermediate steps; all "cutting and trying" and laying out on the drafting board is eliminated. If the distance between centers and the diameters of any one pair of steps is known, L can be determined by the use of Formula (1). The diameter d of the smaller of any other pair of steps having the same center distance C and any desired speed ratio m with the same belt length L, can then be determined by Formula (2). The diameter D of the larger pulley is found by multiplying the diameter d thus determined by m. For the special case where the diameter of the driving pulley is to be the same as that of the driven pulley we may use the formula

$$D = d = \frac{L - 2C}{\pi} \quad (3)$$

Within the limits of usual practice, these formulas will give very accurate results. The length of a crossed belt may be obtained by the formula

$$L = \pi \times \frac{(D+d)}{2} + 2C + \frac{(D+d)^2}{4C} \quad (4)$$

and the pulley diameters may be determined from the formula

$$d = \frac{D_1 + d_1}{m+1} \quad (5)$$

in which D_1 and d_1 are the known diameters and d the diameter required for the smaller of another pair of pulleys, the speed ratio of which is m.

* * *

The present record production of Ford cars is 5380 in a single day. It is expected that this record will be surpassed during the spring.

Punching Rotor and Stator Laminations

A Description of Three Piercing and Blanking Dies that are Used in Sequence in the Manufacture of Laminations for Small Electric Motors

By CHARLES O. HERB

ECONOMY in punch press work demands that the scrap be reduced to a minimum. There is perhaps no better example of the maximum utilization of stock than in the practice commonly followed in punching rotor and stator laminations for induction motors. It is customary to punch both laminations from one strip, those for the rotor being punched along the center line of the strip at a center-to-center distance slightly greater than the outside diameter of the stator laminations, and the latter being punched around those for the rotor. By this procedure the only scrap produced is the small amount blanked from around the stator laminations.

Sometimes the holes and slots are punched before separating the laminations from each other and from the strip, while in other instances they are punched afterward. The rotor and stator laminations for small motors of 1/8, 1/6, and 1/4 horsepower capacity, made by the Gillespie Eden Corporation, Paterson, N. J., for driving the washing machines of its manufacture, are produced by the first of these two methods. The construction of the dies used will be described in this article. Each of these dies averages about 40,000 punchings between regrindings.

Slitting the Stock and Punching the Rotor Laminations

Electric sheet steel stock, 0.022 inch thick, which comes to the plant in sheets 34 inches in width and from 5 to 8 feet in length, is used for the laminations. These sheets are run through a gang shear, which cuts them into five strips 6 5/8 inches wide. The strips are then brought to a row of three power presses, two of which are equipped with dies for piercing the various holes and slots, while the third is supplied with blanking equipment. The sequence of operations is illustrated diagrammatically in Fig. 1. It will be obvious that as the stock is fed from right to left the rotor holes are punched by the first machine, the stator holes and slots by the second machine, and the parts are separated by blanking in the third machine. The diameter of the rotor laminations is 3 1/2 inches, and that of the stator laminations 6 3/8 inches.

Fig. 2 shows the press and die employed for punching the rotor holes. This press is equipped with an automatic feed, which has a finger that engages one of the punched holes and, through a bellcrank lever, pulls the strip of stock to the left between the strokes of the press, to bring it into position for each successive stroke. A rotor die that differs somewhat in construction from that illustrated in Fig. 2 is shown in Fig. 4. It will be seen that the punches for producing the holes are held in a block *A*, which is attached to the punch-holder by means of fillister-head machine screws. The holes are pierced as the punches enter the holes of die *B*, which is a press fit in ring *C*. Stripper plate *D* is located above the die-block the desired amount by means of blocks *E*. The production on this machine is 1900 laminations per hour. The working members of this punch and die and of all others used in the plant of the Gillespie Eden Corporation are made from "Mangano" steel, manufactured by the Latrobe Electric Steel Co., which is an oil-hardening, non-shrinking alloy steel.

Die for the Stator Laminations

The press in which the next operation is performed is so located that its operator can conveniently reach the strips

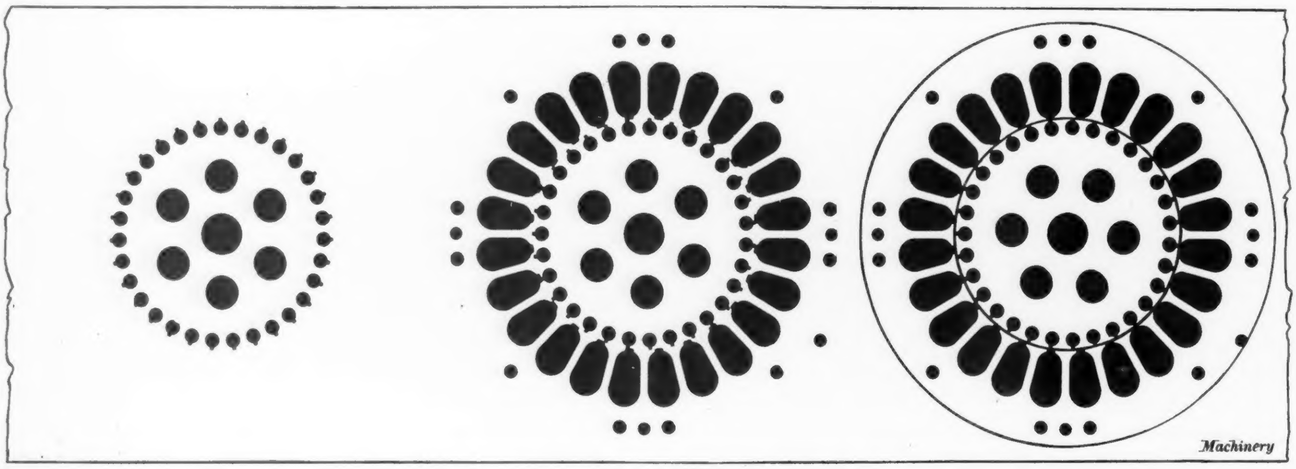


Fig. 1. Diagrammatic Views of the Sequence of Operations as the Strip Stock is fed from Right to Left through Three Power Presses

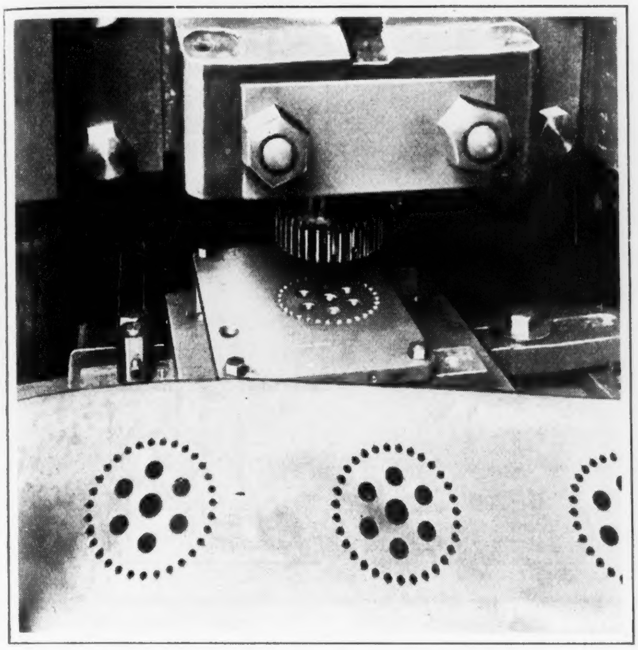


Fig. 2. Press equipped with Die for piercing the Rotor Holes

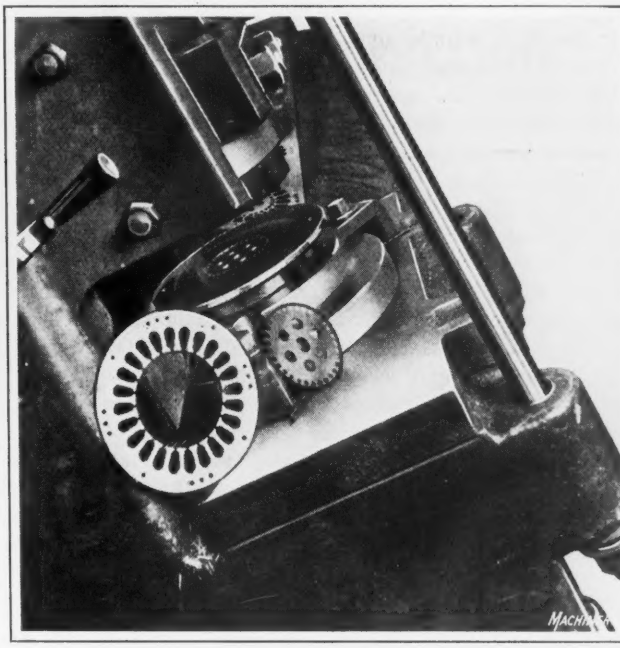


Fig. 3. Inclinable Press equipped with Blanking Die

of stock as they come from the rotor punching machine. In the second operation, as will be seen by referring to the central diagram in Fig. 1, twenty-four elongated holes, or slots, are punched immediately around the thirty-one outer holes of the rotor, and there are seventeen small-diameter holes located outside the ring of slots.

The heading illustration shows the method of feeding the stock between the stripper plate and the die for the second operation, in which the stator slots and holes are pierced. As the punch descends, a pilot at the center enters the hole pierced at the center of the strip by the rotor press, and aligns the strip properly for this operation. A close-up view of this set of dies is shown in Fig. 6, and an assembly view in Fig. 5. One of the interesting features of this die is that the row of punches *A*, Fig. 5, for the slots, are integral with block *B*. The smaller-diameter punches are inserted pins held in a ring *F* in which block *B* is a press fit.

An advantage claimed for this construction is that a larger number of regrindings can be obtained than with a sectional punch. The practice has been followed for a number of years by this company with entire satisfaction. The punches are hardened by dipping to a depth of 3/4 inch in a lead pot, and quenching in oil. This procedure hardens the point and leaves the remainder of the punch soft, so that in case a punch breaks off it may be readily milled out and a new one substituted. The punch and die members are made to size and then hardened, there being practically no shrinkage in hardening.

The pilot that aligns the strip on the downward stroke of the press ram is indicated at *C*. The punch-holder is held in alignment with the die by two guide posts 1 3/8 inches in diameter. Pilot *C* is a press fit in block *B*, and stripper plate *D* is supported on the die-block by four posts which are screwed into the block. Die *E* is machined from one solid piece, and is hardened all the way through. Approximately 1500 punchings are made per hour with this equipment.

Blanking the Laminations from the Strip

The separation of the two laminations from each other and from the strip stock is accomplished by means of the inclined power press illustrated in Fig. 3. Two laminations, after being separated, are shown on the die bolster. The

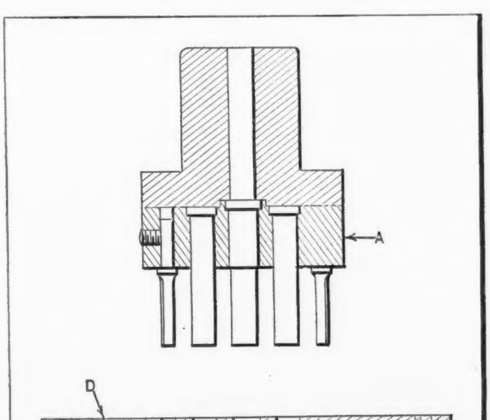


Fig 4. Construction of Die for punching the Rotor Holes

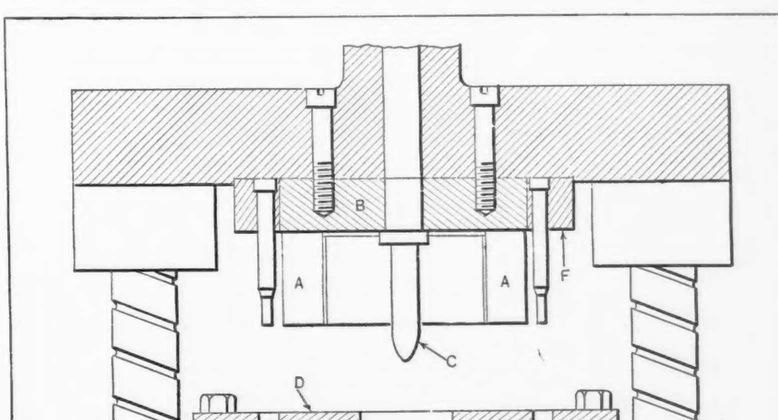


Fig. 5. Stator Die in which All the Punches for the Slots are Integral with a Block and the Die Member is made of a Solid Piece of Steel

construction of the die with which this press is equipped will be more readily understood from the sectional view in Fig. 7. The strip is also aligned for this operation by a pilot entering the central hole, on the downward stroke of the ram. The rotor lamination is blanked as the face of punch *B* passes the inner cutting edge of die *C*, and the stator lamination is blanked simultaneously, as the face of ring *D* passes the outer cutting edge of die *C*. Stripper ring *E* which is acted upon by eight compression coil springs, holds the stator lamination firmly against the face of die *C* during the blanking, and at the same time stripper ring *F* holds the stock that surrounds the stator lamination firmly against punch ring *D*. Stripper ring *F* is supported by four coil springs and is attached to the die-block *G* by means of fillister-head machine screws that pass through the center of the springs.

As the rotor laminations are blanked they drop through the die and die-block and are automatically stacked on a round rod which is replaced from time to time as it becomes filled. Similarly the stator laminations slide through the inclined frame of the press after they have been separated from the strip and are automatically stacked on a rod at the back of the machine. By stacking the laminations in this manner, they may be conveniently handled in subsequent steps. This blanking press is operated at about 1300 strokes per hour. The laminations as they come from this operation, are clean cut without burrs either around the edge or around the pierced holes, and may be assembled without filing.

Assembling the Laminations

As the rods of stacked laminations accumulate, they are immersed in a hot soda solution to clean them from oil and dirt, after which the stacks are hung up to dry. As previously mentioned, the rotor and stator of all motors made by this company are made up of laminations of the same dimensions. However, a different number of laminations is supplied for the different sized motors. For instance, the rotor of a 1/6-horsepower motor is built up of more laminations than the rotor of a 1/8-horsepower motor. The number of laminations to be used in both the rotor and stator of a given sized motor is determined by weight, a small accurate scale being used for weighing the laminations.

The rotor laminations are assembled by means of copper bars inserted through the holes around the center of the laminations and through a ring placed on each end. The bars are riveted under a hydraulic press, the lower die of which has depressions to accommodate the round head on the bars. This method results in a compact assembly. The stator laminations are assembled in a similar manner by inserting pins through the holes that surround the slots, but no end rings are used. The assembled rotor is next subjected to a hot solder bath, and then dipped in a flux

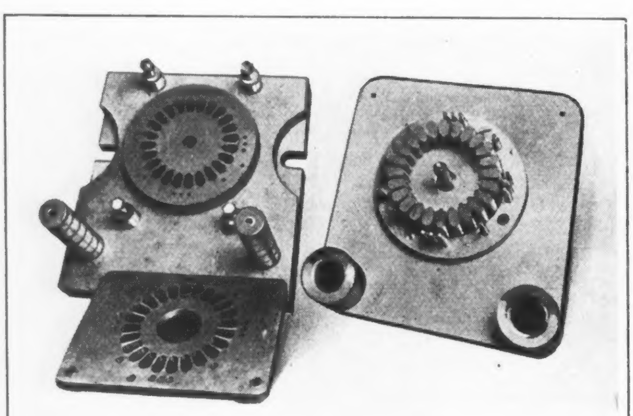


Fig. 6. Punch, Stripper Plate, and Die used for punching the Holes in the Stator Laminations

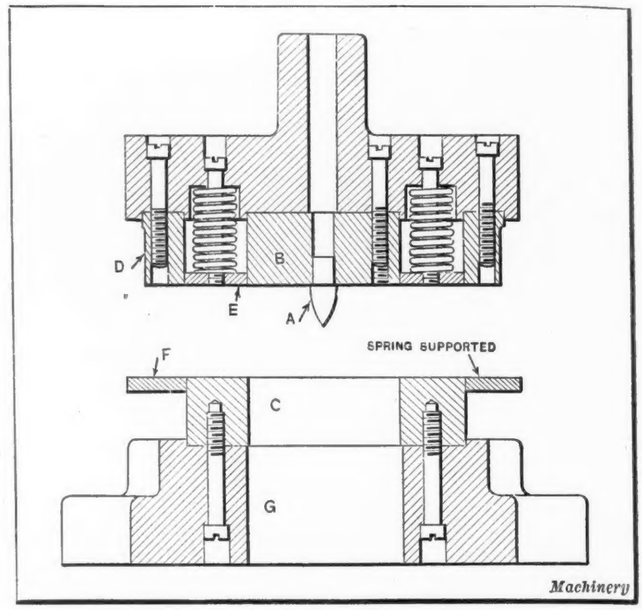


Fig. 7. Blanking Die which separates the Rotor and Stator Laminations from Each Other and from the Strip of Stock

to neutralize acids. The result is a solid joint between the end rings and the laminations. The outside of the rotor is finally ground to size, while the stator is ground both on the inside and the outside.

* * *

STANDARDIZATION DURING 1922

The year 1922 saw a greater activity in industrial standardization than any former year. One of the important accomplishments was the organization of the Federal Specifications Board—which develops and approves the specifications under which all government purchases are made—and the development of a plan of cooperation between this board and the American Engineering Standards Committee with headquarters at 29 W. 39th St., New York City. The organization of Secretary Hoover's Division of Simplified Practice, and its entrance into the industrial field, has had a highly stimulating effect on the industrial standardization movement.

Great advances have also been made by various industries along standardization lines. More than 120 different standardization undertakings are now under way, 43 of them having been initiated within the last year in cooperation with the American Engineering Standards Committee. Of the twenty-eight industrial standards developed and approved by the committee since its organization in 1918, thirteen were approved within the past year. The efforts to develop national safety codes have begun to bear fruit. Six of these safety codes have been approved during the year, covering among other subjects abrasive wheels, foundry practice, power presses, electrical safety, and the protection of heads and eyes of industrial workers.

The last year also saw important developments in international standards. There are now national standardization bodies in fifteen foreign countries, and plans are under way for the development of standardization work in each of the South American republics. The most recent of the national standardization bodies is the Australian Engineering Standards Association, which held its first meeting during the month of November.

One of the most encouraging developments of the year has been the interest in standardization shown by many trade associations in the United States. These associations have a great opportunity for developing industrial standards and for putting them into effect. Standardization is a legitimate and constructive activity of trade associations, and is one of the fields in which such associations can perform some of their most valuable work.

The Work of the Bureau of Standards

WHAT does the Bureau of Standards do? What facilities has it for carrying out industrial and scientific investigations? What is the scope of the work undertaken, and what kind of problems is it prepared to solve? These are questions that arise in the minds of manufacturers and engineers when the Bureau of Standards is mentioned. The work of the bureau is so diversified that it is quite difficult to obtain a comprehensive idea of its manifold activities, except by a visit to its laboratories in Washington, but a brief review will indicate in a general way the scope of its activities and the character of its work.

Standards of Weights and Measures

Originally the Bureau of Standards was mainly a government agency that preserved for comparison and duplication the standards of length and weight (mass). This function, of course, the bureau still retains, in addition to its many other activities. In what is known as the "standard vault" are preserved the national standards of length and weight. Here is a standard meter made in 1797, and a yard made about 1830, as well as standard weights dating back to the early part of the past century. In addition, there are many standards made at a later date.

The length and weight comparators are kept in a "constant temperature room," and are used for fundamental comparisons of length and mass under conditions controlled so that the highest precision can be obtained. The standards with which comparisons are made can be kept at a constant temperature within 0.1 degree F. A comparator is also available for standardizing precision steel tapes, such as are used in very accurate surveys. The room in which this work is done can be kept at any temperature from 32 to 110 degrees F. The bureau also cooperates with the state and local authorities for the inspection of trade weights and measures, by annual conferences with the officials engaged in such work, by the distribution of handbooks relating to the technical details of weight and measure inspection work, and by consultation and correspondence.

Laboratory for Accurate Determination of Weights or Mass

In the laboratory for accurately checking weights, there are a number of balances and sets of precision weights that are used for certifying weights in sets of high precision used in scientific work and in the industries. In this laboratory there are scales that are accurate to within 1/100,000 of a grain, while other scales available in the laboratory are accurate to 1/10,000 of a grain. The ultimate reference standards that are used are kept in a vault and are brought out only at intervals of many years. The secondary standards are the basis of the manufacture of all weights and balances used in trade and in the industries in which weighing is a necessary operation.

Precision Gage-blocks, Screw Threads, and Graduations

The Bureau of Standards developed in this country the original methods for producing, heat-treating, and standardizing precision gage-blocks. These gages are accurate within five-millionths of an inch. Some of the gages, under favorable conditions, are made accurate within one-millionth of an inch. The knowledge and experience gained by the Bureau of Standards in this work is now available to all manufacturers of gages.

In the laboratory for producing master screws of the highest precision, the bureau has developed machinery and methods whereby master screws accurate to within 1/25,000 of an inch can be made. The accuracy of ruled scales has also been developed to a high degree of precision, and the bureau is able to graduate scales on glass with 100,000 graduations to the inch.

Absolute Standards of Length

Since possibly all metals change in the course of time, the standards of length have been actually measured in terms of wave length of cadmium light rather than by the length of a metal bar. The bureau is now able to produce ruled standards of length, determined directly from the wave lengths of light. The highest precision so far attained is within 1/100,000 of an inch for each ruled division. This work is being performed for and at the request of the gage-making industry. Wave lengths of light are measurable to within one two-hundred-and-fifty-billionths of an inch.

Industrial Research

In addition to the scientific work done by the bureau, the work also covers original investigations pertaining to a great number of industrial processes. It is provided with a ten-million pound testing machine for testing the strength of materials. This is the largest testing machine in the world. At present it is used for testing the members of the At the present it is used for testing the members of the Delaware River Bridge connecting Philadelphia and Camden.

In the rubber laboratory the bureau is investigating the power losses that are due to the use of different types of automobile tires. This loss is high, and the bureau has developed types in which these losses are minimized. The preventable waste in this field would save many thousands of dollars worth of gasoline a day. The bureau is also testing to destruction many kinds of tires, to find the cause of failure. In the paper laboratory there are miniature experimental paper making machines, capable of producing paper from different kinds of fiber, and experiments that are of value to the paper industry are undertaken there. In the textile laboratory there is a complete experimental cotton mill, which duplicates the process from carding to weaving, and in which original investigations are made relating to different textile processes. In another laboratory investigations are made covering the processes used in producing pottery, brick, refractory materials, and optical and other glass.

The automotive power plant laboratory is unusually complete, and the bureau has designed, constructed, and put into use an equipment mounted on an automobile which records automatically all the factors influencing the effect of the design of an automobile. The resulting data will be free to the entire automobile industry.

In the radio field, the work in progress includes the standardization of radio measuring instruments. The bureau first developed the direction finder, the radio compass, and the radio beacon. The recent work on short wave lengths with reflectors that throw out the radio energy in a given direction only is of unusual interest. The possibilities of the radio are only beginning to be realized.

These are only a few examples of the type of work that is done by the Bureau of Standards, and manufacturers who find themselves confronted with problems that require scientific investigations should take advantage of the facilities of the bureau and should present and talk over their problems with its scientists and engineers. The Bureau of Standards has been designated by Mr. Hoover as the largest and most complete industrial laboratory in the world.

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MACHINE TOOL STATISTICS

As the accuracy of the machine tool statistics published in January MACHINERY has been questioned, they have been rechecked by the Census Bureau and found to conform to the returns made by the machine tool manufacturers.

* * *

STANDARDIZATION ADVANCES

The American Engineering Standards Committee in its annual report says that one of the most encouraging developments of the year has been the interest in standardization shown by many trade associations. The standardization of industrial products offers unusual opportunities to manufacturers' associations, and their activities in that work will result in important economies, not only in the industries they represent, but for their customers and the public generally. The National Machine Tool Builders' Association has already taken up the standardization problem, but more active cooperation of manufacturers of machine tools among themselves and also with their customers, is urgently needed. Other associations of engineers and manufacturers are working steadily toward standardization, and it is quite possible that some standards will be adopted and accepted by engineers in general that will not be satisfactory to machine tool builders, unless they take an active part in this work. Such standards may cause considerable trouble if adopted by large engineering societies, and the only certain way to prevent this is for our machine tool builders to help in guiding the movement of standardization so that there will be no lack of harmony between the various industries.

* * *

RED TAPE IN LARGE PLANTS

Frequently the large shop is at a disadvantage compared with the small one because of the elaborate organization required to keep things running smoothly when there are several different departments. Most large plants have a special department for making repairs of machines or equipment—apparently an economical method, but having both advantages and disadvantages. One disadvantage is that when an important machine breaks down and production is held up, it may not always be possible for the repair department to handle the work immediately, and several hours, or even days, may pass before the needed repairs are begun. Written orders may also have to be prepared and approved by several different men. The system of the large plant naturally tends to develop red tape, which increases the difficulty of getting emergency work done promptly. System is necessary; the problem is how to prevent too much of it.

No general rule would be applicable in all cases, but a simple remedy is to modify the system so that an emergency can be met immediately. We have in mind an instance when the superintendent of a manufacturing department in a large plant telephoned a shop a hundred miles away to rush some needed repair parts by motor truck. The parts arrived the next morning and before noon the repaired machine was again in operation; but, as required by the system, the manufacturer who delivered the parts received the customary request to bid on them the day after they had been installed, and the formal order for them about a week later.

FEW DESIGNERS ARE WRITERS

Why do engineering journals receive more articles for publication from the men engaged in production work than from those who design the machines, tools and methods for the production? Comparatively few machine designers record the results of their experience and training in writing, although they should be unusually well qualified to do so. Their work frequently brings them in contact with new developments, new mechanisms and new methods for doing work. An important part of their business is to keep in touch with what is done in other shops; but how can this interchange of ideas be effected unless machine designers record their knowledge and experience more frequently in the technical press?

The designer should be especially qualified to contribute to engineering journals, because he is able to make clear and accurate drawings—something that the shop man cannot always do. The designer is accustomed to explain orally the workings of mechanisms and the reasons for his designs, and it should be comparatively easy for him to put these explanations in writing. His experience should enable him to separate the commonplace from that which is new, interesting and ingenious; and in consequence to prepare material for publication that would be of great value. Why is it, then, that technical journals receive comparatively few articles from this class of men and so many from shop men?

* * *

SIMPLICITY IN MACHINE DESIGN

Machine designers are realizing more than ever that simplicity in design is good practice, since a complicated mechanism is more costly and more likely to give trouble than a simple one.

Almost any mechanical action or result can be obtained, provided there are no restrictions to the number of parts used and to the manufacturing cost; but in the machine-building industries it is evident that the best designs are those that pass the commercial as well as the purely mechanical test. A machine may function as intended, but unless it will sell for more than cost it is a commercial failure.

The degree to which a mechanism can be simplified usually depends chiefly upon the principle underlying the design. By way of illustration: A certain type of machine now on the market requires an automatic feeding mechanism which must be so designed that it will transfer drawn shells from a magazine or main source of supply and present them to the operating tools. These shells have one closed end, and the feeding mechanism must be so arranged that each shell is automatically presented to the tools with the open end up to prevent tool breakage. One design of this feeding mechanism is complicated and costly, but it evidently has been simplified as far as the principle employed will permit. Another feeding mechanism serving the same purpose, much simpler and more compact in design, is mechanically superior to the first because the basic operating principle is simple.

Usually there are several ways of accomplishing a given result mechanically, and after devising one method it is advisable to try out others until the simplest possible one is found. Many designs in operation are unnecessarily complicated because the first principle that met the operating requirements was adopted without studying others.

Fair Play for Railway Shop Executives

FOR years the railroads have been easy and inviting targets for writers in the daily press and the popular magazines—easy, because we all have our grievances against the roads at one time or another; inviting, because criticism of railroads and railroad managements is popular with most readers, often for good reasons.

In the field of trade and technical journalism the railroads are not spared either, but generally speaking, the technical journal stands on different ground and is primarily interested in efficiency and not in winning applause. The industrial journals are constructive, and necessarily so. Still it is true that in the industrial journals, criticism is sometimes directed against the railroad shop because of antiquated methods and equipment, without adequate effort to place the blame where it really belongs.

This is not a plea for the railroad shop, but an appeal for fair play for the railway mechanical department. It is true that the average railroad shop is no model of productive efficiency, compared with first-rate manufacturing plants. But the comparison should be on a fair basis. To begin with, nearly all railroad shops are repair shops. Hence, repair methods rather than production methods must be employed, and relative efficiency should be measured by that yardstick. It will have to be admitted, nevertheless, that even if the railroad repair shop is compared only with the average repair shop in other fields, there has been, and is, a good deal of inefficiency. The superficial observer too often puts the blame upon the mechanical management, which is erroneous and unfair. But who is responsible? That is the question.

The men directly responsible for efficiency and output of railroad shops seldom or never have adequate authority to run the shops in accordance with their own ideas of efficiency. They have no power to purchase even the most ordinary supplies and tools. They receive little or no encouragement in their efforts to put the shops on an efficient commercial basis. This lays them open to attacks from all sides, on the basis of an inefficiency that they are powerless to remedy.

As a matter of fact, the men in charge of railway mechanical departments average up with capable executives in other industries. They would like to make as good a showing of shop efficiency as any other executive, and would if they had the equipment and authority. The examples of modern practice copiously spread before them every day by periodicals like MACHINERY spur them on—but in vain. Efficiency is largely a matter of tools, and they are denied the tools of efficiency. The result is that they get discouraged, and chafe under conditions and rules and limitations that kill initiative. It is not their fault if the average railroad shop falls behind in the procession. They do the best they can with the tools they have.

A great deal of credit is due these men for the skill, resourcefulness and ingenuity they so often display in getting results with antiquated equipment. They do remarkably well in keeping rolling stock in working condition, handicapped as they are and have been for years and years. For it is not only adequate machine tool equipment they lack, but also the most ordinary types of small tools.

A well-known salesman of a leading line of machine tools, with a broad acquaintance in the railroad field, writes us:

"The question so often asked 'What is wrong with the railroad shops?' can be answered in three words—*the general management.* The trouble is not with the shop management. Let me quote a few examples. One master mechanic told me he was unable to get the purchasing department to buy a 1-inch twist drill badly needed—to say nothing of all the other things he needed and could not get—so he made a drill in his own shop! The same railroad, in the interest of economy, laid off most of its track-walkers. This was followed in about a week by a wreck due to a broken rail, which presumably might have been discovered by one of the track-walkers if he had been kept on the job. The wreck cost a good deal more than all the twist drills and all the track-walkers would have cost for a very long time.

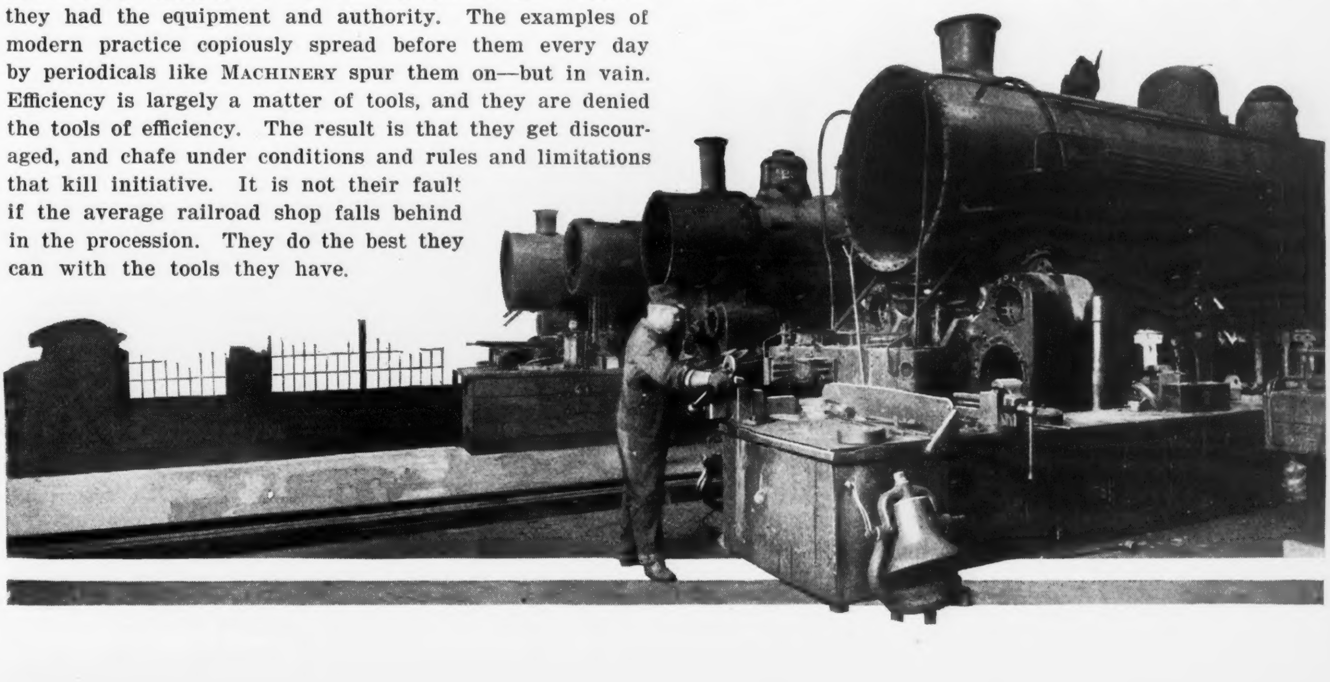
"Another master mechanic was unable to get a 1¼-inch steel bar, and had to get along with an old axle much too large in diameter, which he took out of the scrap pile and turned down.

"The worst of it all is that it is simply mistaken and costly economy. How much did it cost to make that 1-inch twist drill in the shop or to turn down the old axle?"

The whole thing is summed up in a terse statement by one mechanical executive. He said, "If we had to sell what we make, we would go broke in a week."

Superintendents of motor power, railway master mechanics and shop foremen will show real results when they are given a chance. In the comparatively few instances where capable and progressive railroad managements look after the shop as well as the traffic end, the railroad shop has developed high efficiency.

The railroad shop, operating with antiquated equipment, is a costly department. If we are to have better railroad shops, this truth must be brought home to the men who control the finances. Put the blame where it belongs.



The British Metal-working Industries

From MACHINERY'S Special Correspondent

London, January 16, 1923

THE best that can be said of the machine tool industry is that the new year undoubtedly opens with much better prospects. Manufacturers as a whole confine their purchases pretty much to new types of tools and machinery which promise immediate economies in production costs. Of late the willingness to buy on the strength of performance has become distinctly pronounced, and each week sees an improvement in the prospects of new business.

The Automobile Industry

It is expected that automobile manufacturers will be taking a fair amount of new equipment as production schemes, during the next month or two, are put into effect. For reasons of economy, automobile manufacturers, in common with many others, stopped buying machine tools long before actual requirements were satisfied, but times are now considered more propitious, and with a good season for the industry fairly well assured, buyers are entering the market with greater freedom. It is evident that automobile manufacturers are intent upon cutting production costs to the minimum. The productive capacity of existing equipment is being carefully investigated—in a number of cases it is found to be hopelessly inadequate—and where conditions warrant replacement with new and better machine tools, these are being immediately ordered. As a rule, simple machines with a proved capacity for continued heavy duty and rapid production are mostly in favor.

In lathe manufacture the biggest volume of trade is undoubtedly in machines with beds up to 20 or 30 feet in length, the standard lengths still being, apparently, largely supplied from munition surpluses.

The Dickinson Machine Tool Co., Keighley, is going out of business, and its works and equipment are to be sold by auction. One of the oldest machine tool shops in Yorkshire, it was founded about the middle of the last century, and has always had a good reputation, particularly amongst textile engineers. Latterly the works were laid out especially for the production of horizontal boring machines, of which large numbers have been turned out during the last few years.

The Second-hand Market

The second-hand machine tool market is relatively brisk, and reconditioned machines of reputable make are selling readily at comparatively high prices. A fair amount of surplus munitions equipment has recently been thrown on the market, or is announced for sale by auction in the near future. For some months past these sales have been conspicuously absent, and although the knowledge that further sales are about to take place may be somewhat disconcerting, they denote at least one thing, which is that machine tools are now considered to be a much more marketable commodity than they have been for the last six months.

Iron and Steel Industry

There is a better feeling in the iron and steel industries. The production of pig iron is steadily increasing, and in November amounted to 493,900 tons, which was the highest monthly total attained since January, 1921. The furnaces in blast now number 162, compared with 77 at the beginning of last year. Steel production in November amounted to 600,800 tons—the highest since December, 1920.

The Railway Field

In the railway field there is a considerable amount of work on arrears of maintenance programs alone, and the payment of the second instalment of £30,000,000 by the Government to the railway companies is expected to give a stimulus to the engineering and other trades. Substantial orders have been received on account of the Indian railways, and tentative orders have been forthcoming for other systems abroad. It is understood that orders already placed for India represent but the initial stages of important plans for railway development and that further large orders are likely to follow. Extensions of the Australian lines are being proceeded with, and many more cars will be required by South America. The railway electrification schemes in hand, both at home and abroad, are also expected to result in valuable orders for rolling stock. Shipbuilding prospects are much brighter than they were a year ago.

New Machine Tools

A new design of all-geared manufacturing lathe has been put on the market by Charles Dale, Keighley. The machine has been designed specifically for a high rate of output. The single pulley drive is coupled to the transmission by a cone friction clutch, the control lever for which is carried in a convenient position on the saddle. This lever, in addition to engaging or disengaging the clutch, also operates a spindle brake so that the work can be brought to rest as soon as the clutch has been disengaged. There are twelve spindle speeds operated by three convenient levers on the front of the headstock.

At the Chiswick Works of the London General Omnibus Co., Ltd., where London's motor buses are systematically overhauled periodically, several interesting special machines have been installed. One of these supplied by John Holroyd & Co., Ltd., is for boring, reaming and running in crankshaft main bearings. There are two spindle heads arranged at opposite ends of the machine bed, which carries a turntable indexing to four positions at 90 degrees to one another. The turntable carries four crankcases. One spindle head drives a boring tool or reamer, as the case may be, and the other supplies the drive for running in the crankshafts after the bearings have been machined. When working continuously one crankcase is completed every twenty minutes.

The range of horizontal boring, drilling and tapping machines manufactured by George Richards & Co., Ltd., Manchester, has been increased by a series of machines of the sliding spindle type, fitted with an automatic facing head.

A new tube-mandrel grinding machine has been produced by the Churchill Machine Tool Co., Ltd., Manchester. This is an adaptation of the company's standard model B plain grinder, and is intended for the rapid handling of round-nosed mandrels, such as are used in tube rolling.

* * *

Of the automobiles built in 1922, Ford produced in the United States 1,233,000 cars, and adding the Canadian and foreign production, the total reached 1,352,000 for the year. The output of Ford tractors was 63,000. The automobile industry as a whole produced approximately 2,500,000 cars and trucks, of which the trucks represented somewhat less than 10 per cent. The outlook for the automobile industry for the coming year is exceptionally bright, and many orders are reported as a result of the automobile show.

Grinding a Cam Slot in a Reference Gage

By W. H. KEEFE

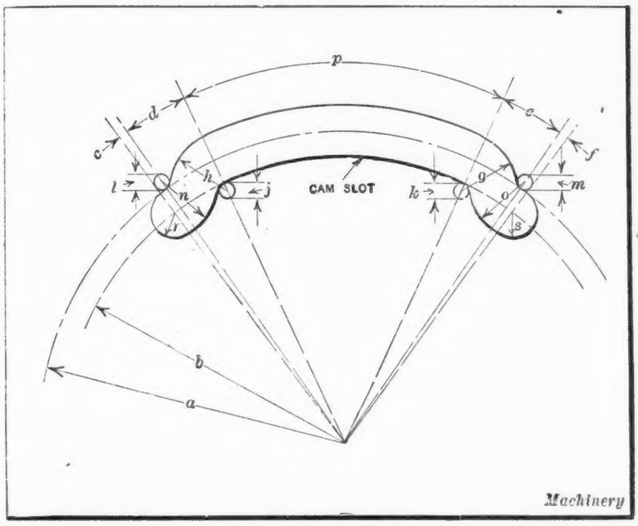


Fig. 1. Outline of Cam Slot in Reference Gage

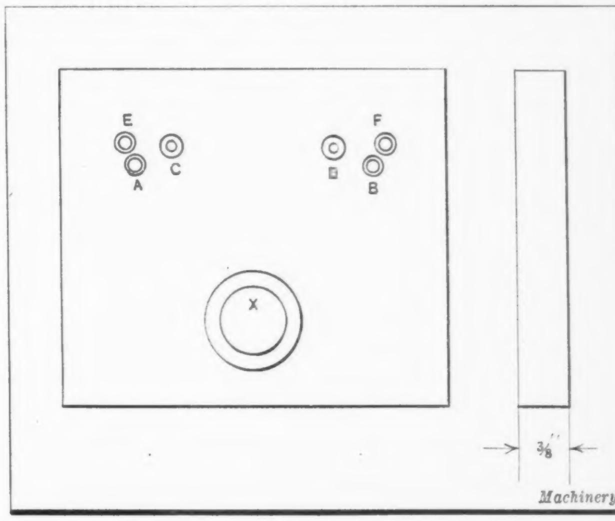


Fig. 2. Master Plate used in grinding Cam Slot

INTERESTING grinding problems are often encountered in the production of cams, profile gages, and similar parts requiring accurate profiles. The cam slot shown diagrammatically in Fig. 1 presents a problem in grinding that is typical of this class of work. The methods and equipment here described, which were employed by the writer in grinding the cam slot, may also be used for a variety of similar work. The description should, therefore, be of general interest to toolmakers and machinists. Referring to the diagram, Fig. 1, it will be noted that reference letters are inserted in place of actual dimensions. On checking up the finished cam slot with precision gages, all the dimensions represented by the letters were found to be correct within the allowable tolerance of 0.0002 inch, and no error could be detected in the angular measurements.

Equipping Bench Lathes for Grinding Operations

The first step in producing the cam-slot gage was to equip a Pratt & Whitney bench lathe of 7-inch swing with bolster blocks to obtain the required swing of 13 inches. The bolster blocks were made of cast iron and were of simple design. A piece of boiler plate, 3/4 inch thick and of sufficient size to make a round plate 12 inches in diameter, was drilled and tapped for clamping screws. This plate was then fastened to the faceplate of a 14-inch engine lathe by passing screws through the slots in the faceplate, and tightening them in the threaded holes of the boiler plate. The prick-punched center of the boiler plate was trued up by the use of an indicator. After rough-boring the central hole to within 1/16 inch of size, the plate was faced off.

The work was next reversed on the faceplate, after which the other side was faced and the outside edge finish-turned to a diameter of 12 inches. The central hole was then finish-bored and threaded to fit a collet stem of standard size, which was made up for use with the special faceplate. A faceplate made in this way will be found very accurate and suitable for various kinds of work. The spindle head of the bench lathe was mounted on one of the bolster blocks attached to the lathe bed, while the cross-slide was mounted on the other bolster block. As there was no occasion to use the tailstock, this part was not taken into consideration.

A Pratt & Whitney slide grinder—or internal slide grinder as it is sometimes called—was used for the grinding operation. The speed of the lathe spindle was reduced and that of the grinder increased by the use of special pulleys. As the narrow slot to be ground necessitated the use of a small-diameter wheel, a speed of approximately 12,000 revolutions per minute was required for the grinder spindle, to obtain the desired results. Hence it was necessary to exercise considerable care in order to prevent the grinding wheel spindle bearings from cutting or becoming abraded. The best results were obtained by running the grinder

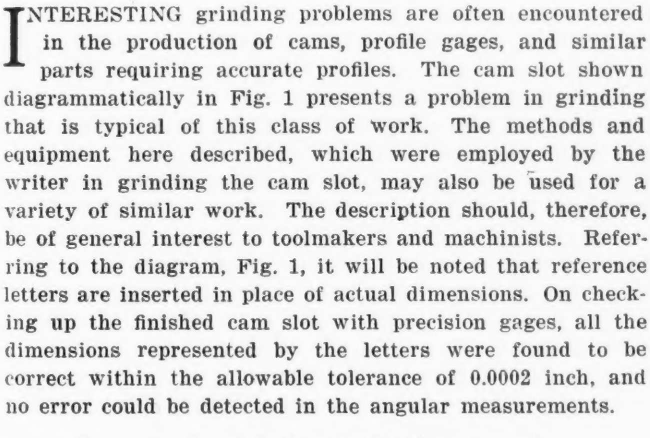


Fig. 3. Diagram showing Two-piece Construction of Gage

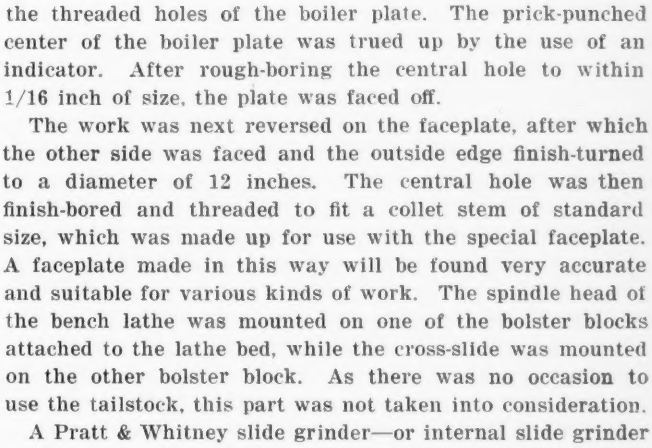


Fig. 4. Roughed out Gage Blank

spindle dry and occasionally rubbing the fingers over it to provide a thin lubricating film.

As the only grinding wheels obtainable of the required size were of too fine a grain for the purpose, it was necessary to make up special wheels. These were made from small square blocks, cut from a larger wheel with a hacksaw. Holes were drilled in the center of each of the blocks of the correct size to fit the internal grinding spindle. Small, thin brass or copper washers were placed on each side of the small wheels or blocks to insure a good grip of the screw and to prevent crumbling. About an 80 K wheel was found to give good results. The harder and finer grain wheels proved unsuitable, mainly for the reason that they were subject to excessive glazing. When used by a careful workman a bench lathe equipped as described is capable of handling a great variety of grinding work.

Master Plate for Gage

A master plate, such as shown in Fig. 2, was next made up. The holes *A*, *B*, *C*, *D*, *E*, and *F* in this plate represent the centers of the radii that determine the outline of the cam slot, as shown in Fig. 1. As the accuracy of the finished gage depends on the location of these holes, extreme care was taken in the laying out and boring operations. Each hole was provided with a hardened, ground, and lapped bushing, having a central hole 0.125 inch in diameter. After inserting the bushings in the master plate, the latter was given a final inspection.

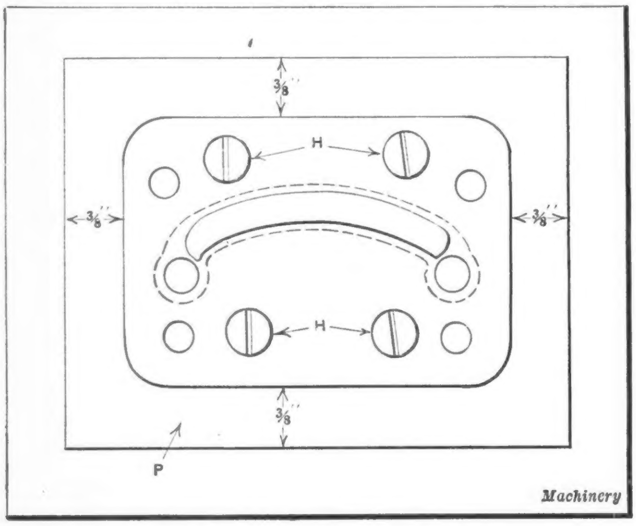


Fig. 5. Gage Blank mounted on Plate Ready for Grinding Operation

Grinding the Gage Slot

The gage itself was made in two pieces, as shown in Fig. 3. The cam slot outlined was laid out or scribed with a height gage and dividers, after which the slot was roughed out, leaving webs *E* at each end, as shown in Fig. 4. The dowel-pin holes shown at *G* were drilled, and the fastening screw holes *H* counterbored, after which the gage was heat-treated to obtain a glass-hard surface. The dowel-pin holes were then lapped, and the edges of the plate ground so as to form a good fit at points *J*, Fig. 6. A 3/8-inch plate *P*, Fig. 5, 3/4 inch longer and 3/4 inch wider than the gage blank, was next procured. The gage blank was assembled on this plate, and secured by screws inserted in the counterbored holes *H*. Before fastening the blank to the plate, the outline of the slot was scribed on the plate, and this section cut away to permit the grinding wheel to pass through the work.

The plate with the work doweled in place was next attached to the faceplate of the bench lathe, the hole corresponding to bushing *A*, Fig. 2, being accurately centered. After grinding the hole thus centered, the master plate shown in Fig. 2 was placed on the work, a stepped plug having steps of 1/8 and 1/4 inch being used to bring the hole in the bushing *A* into alignment with the hole just ground. The master plate was then pivoted on the stepped plug, or swung around until the roughed out hole in the work at *B*, Fig. 4, was in line with the bushing *B*, Fig. 2, of the plate. When the correct position was obtained, the master plate was clamped to the work, the hole ground, and another stepped plug inserted in bushing *B*. This plug was then employed in locating the work on the faceplate preparatory to finish-grinding the section of the cam slot formed by the hole *B*, Fig. 4. The master plate and the stepped plug were used to check up the chordal distance between the centers of holes *A* and *B*.

The next operation was grinding that part of the cam slot profile determined by the radius located by bushing *C*, Fig. 2. The method of locating and grinding this surface, as well as the corresponding one located by bushing *D*, was identical with that employed in the case of holes *A* and *B*, except that the lower member of the gage was removed for the grinding operation. The sections of the slot profile which have 0.2700 inch radii *h* and *g*, Fig. 1, were checked up by the use of a stepped plug having 1/8 inch and 0.540 inch diameter steps.

The section of the cam slot determined by the radii located by bushings *E* and *F*, Fig. 2, were next ground.

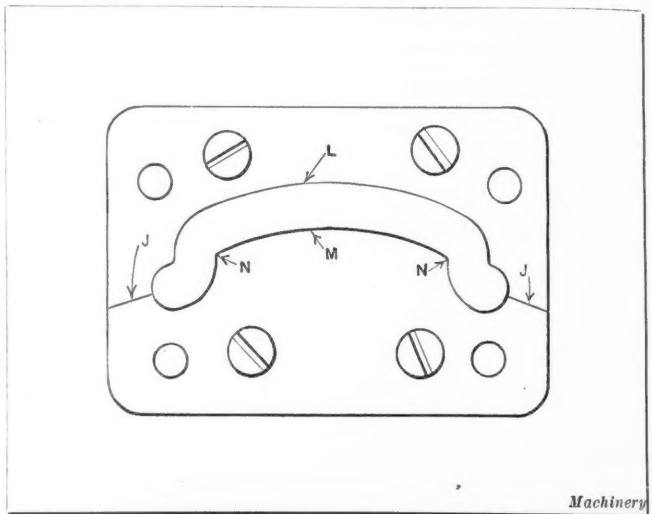
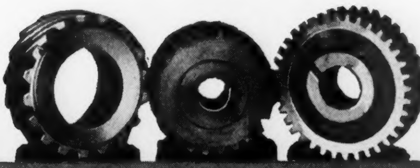


Fig. 6. Completed Reference Gage for Cam Slot

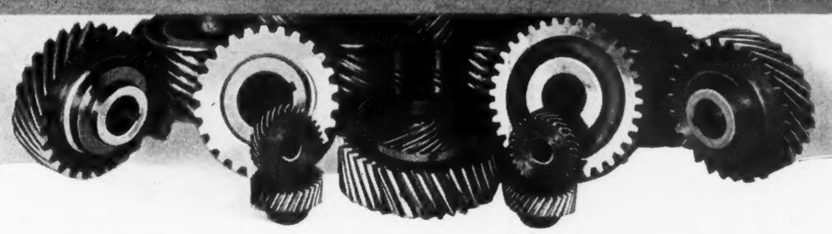
Only two settings of the work on the faceplate were required for these grinding operations, as the sections ground on the upper and lower members of the gage were located by radii having common centers. In these grinding operations it was necessary to grind away the webs indicated at *E*, Fig. 4. This was readily accomplished by keeping the wheel in good condition by frequent dressings with a diamond or a piece of carborundum and making no attempt to crowd the wheel.

In grinding the top and bottom surfaces *L* and *M* of the cam slot (see Fig. 6), bushing *X* of the master plate, shown in Fig. 2, was made to serve as a pivot bearing, so that the work could be swung through the required arc. In the final grinding operations, the work was relocated on centers corresponding to bushings *C* and *D* and the corners of the lower part of the slot, at *N*, Fig. 6, were ground to the required radius. After this was done, a piece of cold-rolled steel 1/4 inch in diameter, held in a drill chuck, was used as a lap in finishing the slot to a perfect plug fit at every point.

While a gage of the type referred to could be made in various ways, the method here described has been thoroughly tried out and has proved satisfactory. This gage is in use at the present time in the plant of a manufacturer in the Middle West who demands the best in machinery and tools.



Methods of Generating Helical Gears



Cutting Teeth of Helical Gears on Hobbing Machines and Gear Shapers

By FRANKLIN D. JONES

GEARING commonly known as helical or spiral gearing is usually cut by some generating method, although milling machines are sometimes used, especially when such gears are not required in quantity. Large helical gears particularly in the herringbone form, may also be cut on planers of the form-copying type and by the end-milling process. The most common generating method employed is that of hobbing, but the shaping or planing processes are also used in many shops. Before dealing with these generating methods, the terms used to designate helical gearing will be considered to avoid misunderstanding, since different names are often applied to the same general classes of gearing.

In the first place, helical gears are commonly known as spiral gears, although the teeth are helicoidal like a screw thread and not of spiral form; the name helical, however, is being used increasingly. Helical gears are applied in different ways, and various terms are used to designate them. For instance when helical gearing is used to connect parallel shafts, the term "twisted spur gear" is sometimes used, because the gearing in this case serves the same general purpose as ordinary straight-tooth spur gearing. This relates to the use of single helical and not the double-helical or herringbone gearing. When helical gearing is used to connect shafts located at an angle, the term ''helical'' or "spiral" is commonly applied, both terms being extensively used. Both of these general classes of gearing have helicoidal teeth, and the principles underlying the methods of cutting them are similar, but the tooth action (when the gears are running together) is quite different, and so also are the functions of the gearing. Thus, twisted spur gears are used to connect parallel shafts in order to secure a smoother action than can be obtained with ordinary spur gears. On the other hand, helical gearing is frequently used as a convenient means of transmitting motion between shafts that are located at an angle and not in the same plane. The foregoing applications of the terms given do not represent standard usage, as there is no standardization of these terms. By way of illustration, some treatises on gearing designate gears for parallel shafts as helical gears instead of twisted spur gears, and those for shafts at an angle as spiral gears. When parallel shafts are connected by gearing having both right- and left-hand helical teeth, the terms "herringbone" or "double-helical" gears are commonly used, the former being more common.

Cutting Helical Gears by the Hobbing Process

Gear-hobbing machines are very efficient for cutting helical gears, and are widely used for this class of work as well as for spur gears. Many machines are used for cutting both spur and helical gears. The general method of cutting helical gears by hobbing is practically the same as cutting spur gears, after the machine is properly geared and adjusted. The angular position of the hob must be determined with reference to the helix angles of both the hob and the gear to be cut, and the machine must be geared to generate helical teeth having the required helix angle with relation to the axis. When the machine is at work, the hob has a feeding movement parallel to the axis of the gear, and, ordinarily, all the teeth are finished during one passage of the hob.

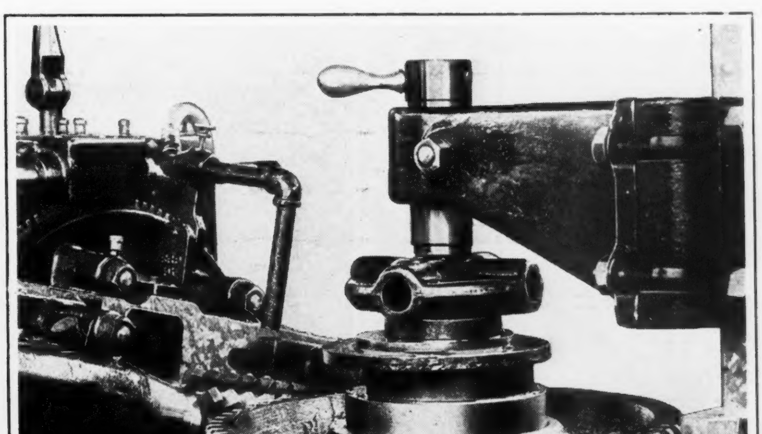


Fig. 1. Cutting a Helical Gear on a Hobbing Machine

The principle governing the generation of helical gears by hobbing is illustrated by the action of a helical pinion meshing with a rack, as embodied in the well-known Sellers planer drive. When a

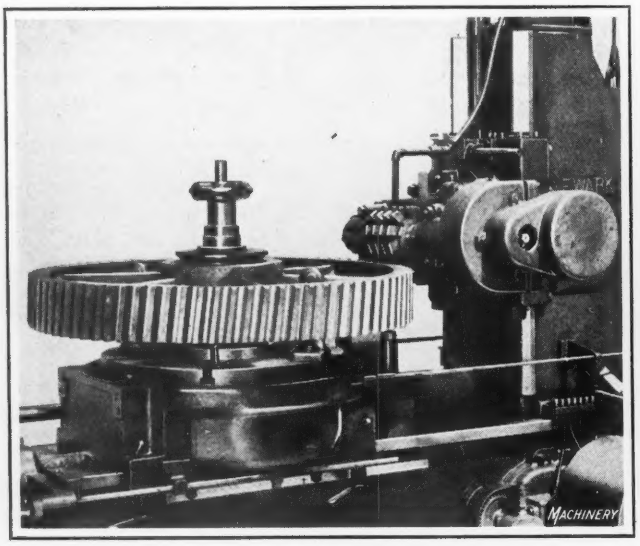


Fig. 2. Cutting a Right-hand Gear with a Right-hand Hob—Number of Teeth 83, Angle 7 Degrees

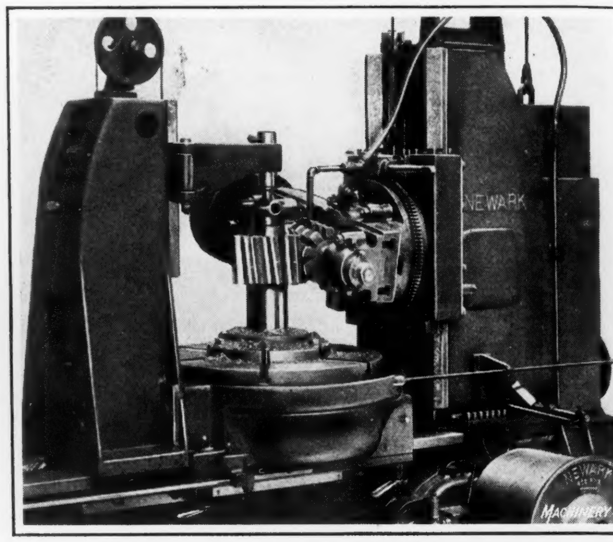


Fig. 3. Cutting a Left-hand Pinion with a Right-hand Hob—Number of Teeth 14, Angle 7 Degrees

helical gear is to be cut with a hob, the latter is set at such an angle that its teeth, as they come around to the cutting position, coincide with the teeth of an imaginary rack in mesh with the revolving gear. Fig. 1 shows the cutting of a helical gear by hobbing. The hob, set at the proper angle, begins cutting at the top of the blank, and the slide carrying it feeds downward, parallel to the axis of the gear being cut, thus forming all the teeth at one passage of the hob. Fig. 4 shows a machine cutting two pinions at the same time. Both of these views are from the plant of the R. D. Nuttall Co., Pittsburg, Pa.

In cutting a spur gear with a single-threaded hob, the number of revolutions of the hob for each revolution of the gear equals the number of teeth in the gear, but in cutting helical gears, the ratio of the change-gears on the machine is affected not only by the number of teeth in the gear to be cut, but also by the lead of the teeth, the relation between the hand of the hob and the gear, and the rate of the hob feeding movement. The formation of helical teeth, as the hob feeds across the gear blank, is accomplished by accelerating or retarding the motion of the work-table. The principle will be made clear by comparing the hobbing of spur and helical gears.

Suppose, for example, that a single-thread hob were used for cutting a forty-eight-tooth spur gear; in this case the work-table would make just one revolution to forty-eight revolutions of the hob. Now, assume that a left-hand spiral gear with forty-eight teeth is to be cut with a left-hand hob; then it would be necessary for the table to revolve somewhat faster than for a spur gear with the same number of teeth. It is this acceleration or increase of rotary motion of the table, as compared with the rotation for cutting a spur gear, that causes the hob, as it feeds across the blank, to develop helical teeth.

In some cases, however, the motion is retarded instead of being accelerated, since this depends upon the kind of hob used. In cutting a left-hand gear with a left-hand hob, or a right-hand gear with a right-hand hob, the table revolves at a faster rate than it would in cutting a spur gear having the same number of teeth. On the contrary, in cutting a gear of opposite hand, the rotation is retarded in order to secure the same effect in generating the helical teeth The plan is to gear the machine so that the table will either gain or lose one complete turn during the time required for the hob to feed a distance equal to the lead of the gear being cut. In actual practice, of course, the total feeding movement is usually only a small part of the lead, since the latter represents the distance that a tooth would advance if it made a complete turn about the gear. [For information on the calculating of change-gears for hobbing helical gears, see MACHINERY'S ENCYCLOPEDIA, Vol. III, pages 363 to 367, inclusive].

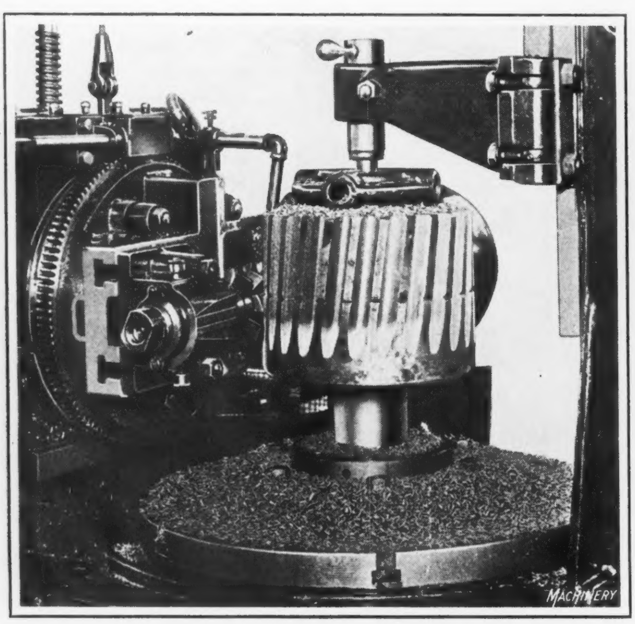


Fig. 4. Cutting Two Helical Pinions at the Same Time

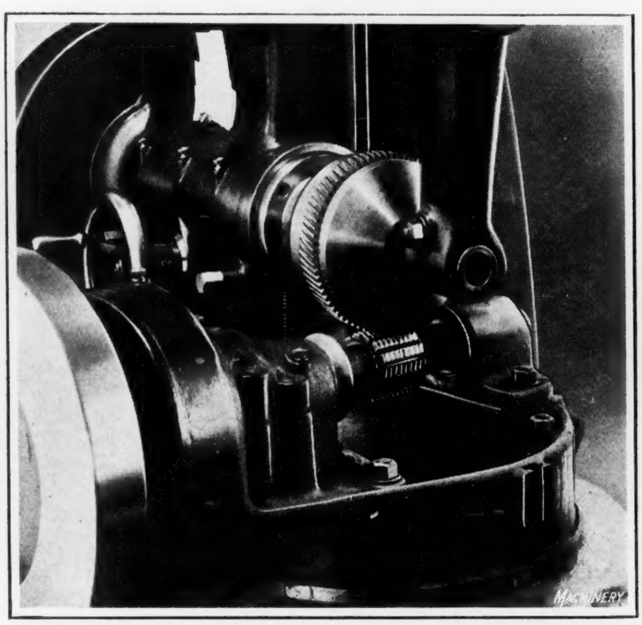


Fig. 5. Cutting Timing Gears on a Horizontal Hobbing Machine

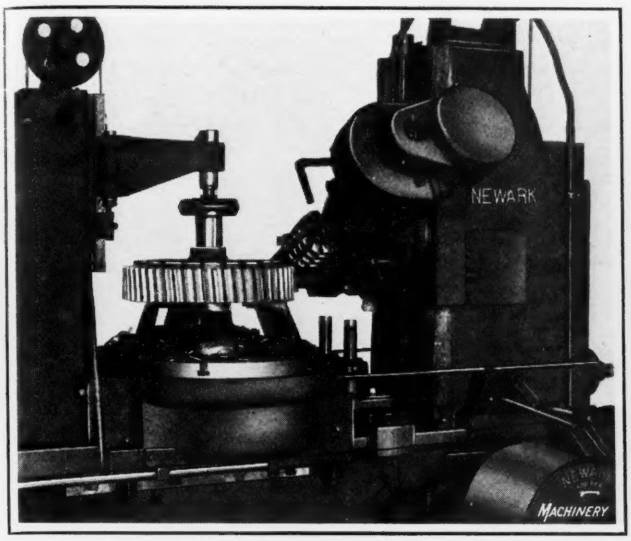


Fig. 6. Machine arranged for cutting Helical Ring Gears

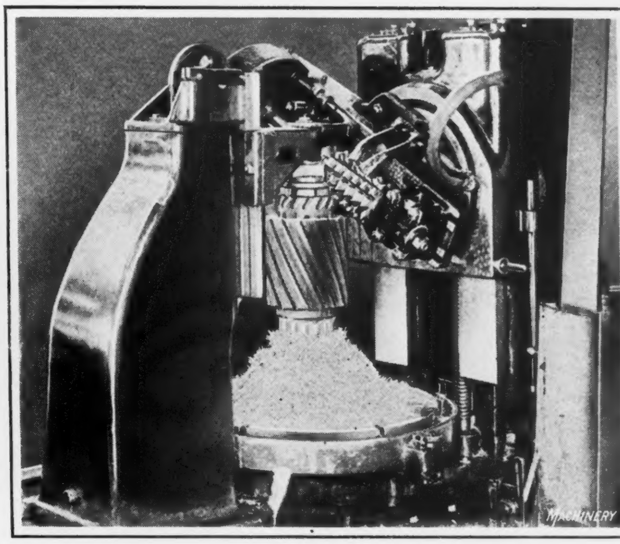


Fig. 7. Cutting Helical Gears made of Chrome-nickel Steel

Angular Position of Hob for Cutting Helical Gears

The angle at which the hob is set for cutting helical gears depends upon the helix angle of the gear and the angle of the hob itself. When a right-hand hob is used for a right-hand gear, or a left-hand hob for a left-hand gear, the hob spindle is inclined from the horizontal position an amount equal to the *difference* between the angles of the gear and hob. The helix angle of the gear is measured from the axis, and the helix angle of the hob (which should be stamped on it to avoid measurement and calculations) is measured from a plane perpendicular to the hob axis and is often referred to as the "end angle." When a right-hand hob is used for a left-hand gear or vice versa, the hob spindle is inclined an amount equal to the *sum* of the gear and hob angles.

When a hob has the same angle as the gear to be cut, and the hob and gear are of the same hand, the hob spindle is set in the horizontal position. This agrees with the rule just given, since the result of subtracting one angle from the other equals zero.

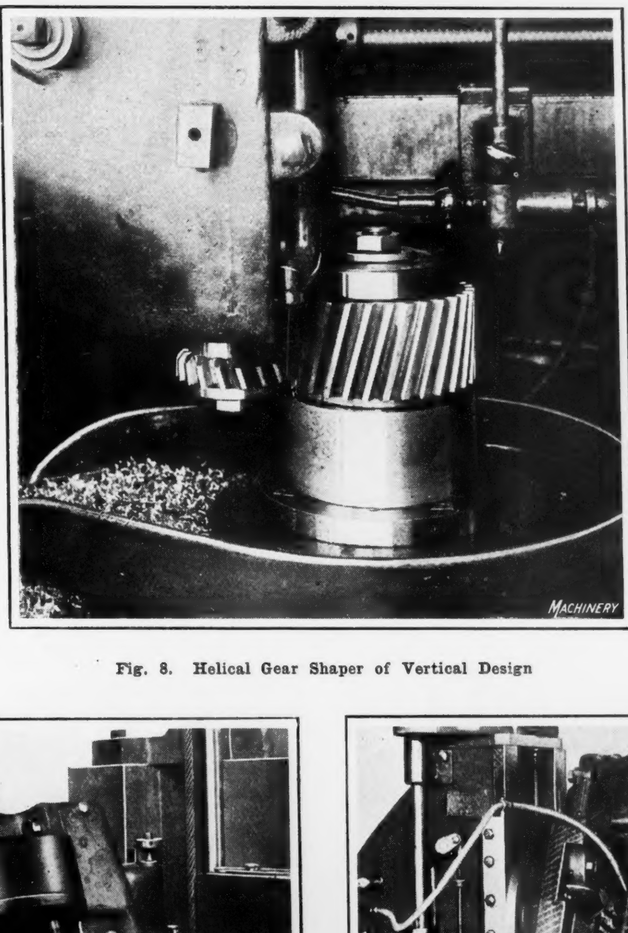


Fig. 8. Helical Gear Shaper of Vertical Design

Selection of Hobs for Cutting Helical Gears

Hobs for helical gears are selected according to the normal diametral pitch instead of the "real" diametral pitch. The latter is the quotient obtained by dividing

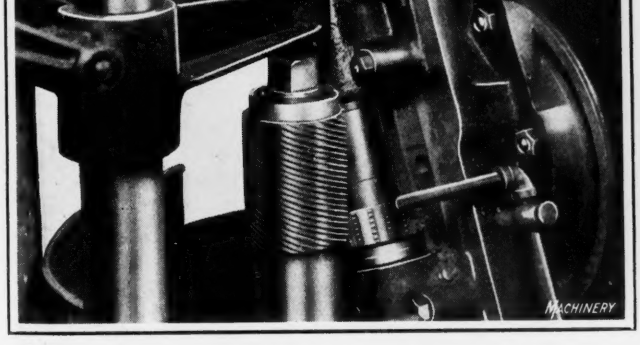


Fig. 9. Cutting Gears having a Large Helix Angle

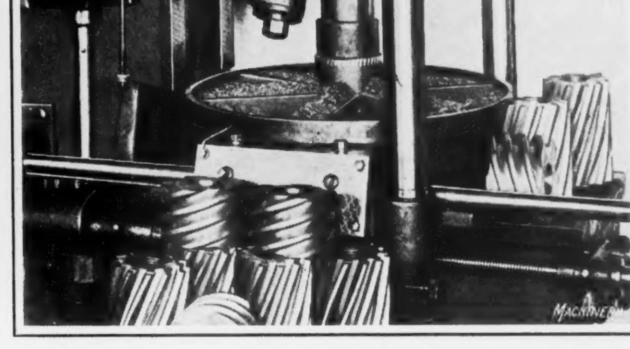


Fig. 10. Hobbing Gears of 70-degree Helix Angle

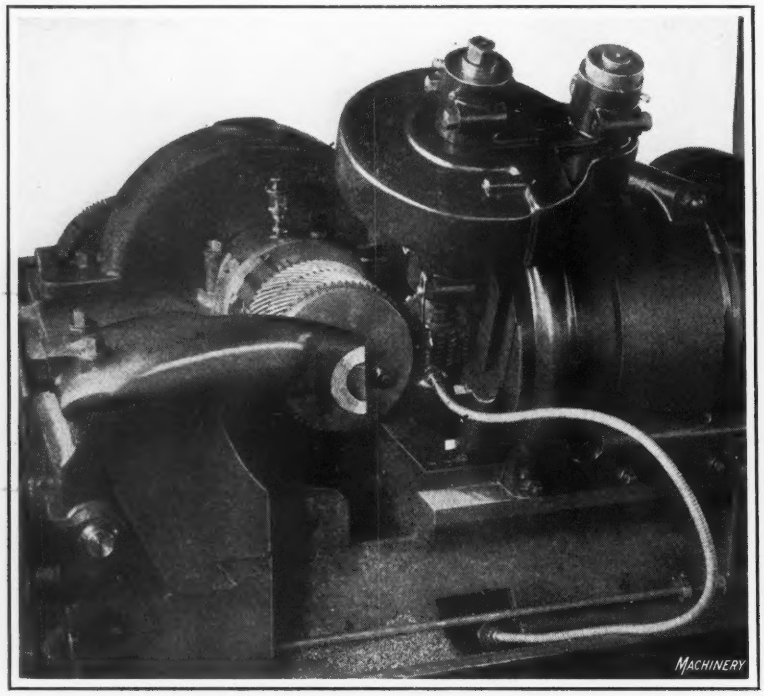


Fig. 11. Horizontal Type of Machine cutting Two Helical Gears simultaneously

the number of teeth by the pitch diameter, as for spur gears. The normal diametral pitch is found by dividing the real diametral pitch by the cosine of the helix angle of the gear.

Whether the hob should be right-hand or left-hand depends upon the gear. As a general rule, it is advisable to use right-hand hobs for right-hand gears, and left-hand hobs for left-hand gears, particularly when the gear is to have teeth of large helix angle. The reason that the hob and gear should be of the same hand for large helix angles, is that the hob has a better cutting action relative to the work, the direction of cut being against the rotation of the gear blank. When the helix angles are not large, a hob may be used interchangeably for either right- or left-hand gears.

Examples of Helical Gear-cutting by the Hobbing Process

The application of gear-hobbing machines to the cutting of helical gears varying considerably in regard to size, pitch, and angle of teeth, will be illustrated by a number of specific examples from practice. Fig. 2 shows a machine set up for cutting a cast-iron helical or twisted spur gear to be used for connecting parallel shafts. This gear has 83 teeth (47.78 inches pitch diameter) of 1¾ normal diametral pitch, a face width of 7 inches, and a helix angle of 7 degrees. This is an example of cutting a right-hand gear with a right-hand hob.

The normal diametral pitch or the pitch of the hob is determined as follows: The real diametral pitch equals $83 \div 47.78 = 1.737$. The cosine of the helix angle of the gear (7 degrees) is 0.99255; hence the normal diametral pitch equals $1.737 \div 0.99255 = 1.75$. Therefore, a hob of 1¾ diametral pitch should be used. This hob is the same as would be used for spur gears of 1¾ diametral pitch, and it will cut any spur or helical gear of that pitch regardless of the number of teeth, provided 1¾ is the diametral pitch of the spur gear and the normal diametral pitch of the helical gear.

The gear shown in Fig. 2 is mounted between stepped flanges on the work-arbor, and there are two drivers bolted to the work-table to prevent any movement of the gear relative to the table as it revolves. The outside supporting column has been removed from the machine for this operation, and the thrust of the cut is taken by two rim rests located below the gear rim on the cutting side. This gear is finished at a single passage of the hob.

The machine steel pinion shown on the machine in Fig. 3 runs with the 83-tooth gear just referred to. This pinion has a pitch diameter of 8.06 inches, and 14 teeth with an angle of 7 degrees. This is an example of cutting a left-hand pinion with a right-hand hob. It will be noted that the hob inclines more than when cutting the mating gear. This is because the pinion and hob are of opposite hand, and consequently the inclination must equal the sum of the gear and hob angles. The diameter of the pinion is too small to permit using a rim rest to take the thrust of the cut, so the upper end of the work-arbor is supported by the column and arm, as shown. The same gearing is used for controlling the lead or angle as is employed for cutting the mating gear, the only change necessary being in the "dividing" gears for the number of teeth.

The helical ring gear illustrated in Fig. 6 is made of bronze, and has 54 teeth of 2½ normal diametral pitch, with a helix angle (measured from the axis) of 5 degrees 45 minutes. The left-hand gear shown on the machine (as well as right-hand gears) is cut with a right-hand hob. The gear rests upon three supports bolted to the work-table, and is held in a central position and clamped, to prevent slipping, by a cast-iron plate located on top of the gear. The three examples referred to represent work done on hobbing machines made by the Newark Gear Cutting Machine Co.

The hobbing of helical gears made of chrome-nickel steel is illustrated in Fig. 7. These gears have 22 teeth of 3 pitch and 7½ degrees angle. The face width is 6 inches, and the cutting time thirty minutes. This is an example of work done on one of the Gould & Eberhardt machines. Another helical gear-hobbing operation on a machine of the same make is shown in Fig. 9. These gears are made of chrome-vanadium steel, and have a pitch diameter of 3¾ inches, and a face width of 1 inch. They are used for driving the speedometer shaft of an automobile. This is an example of cutting helical gears having a large helix

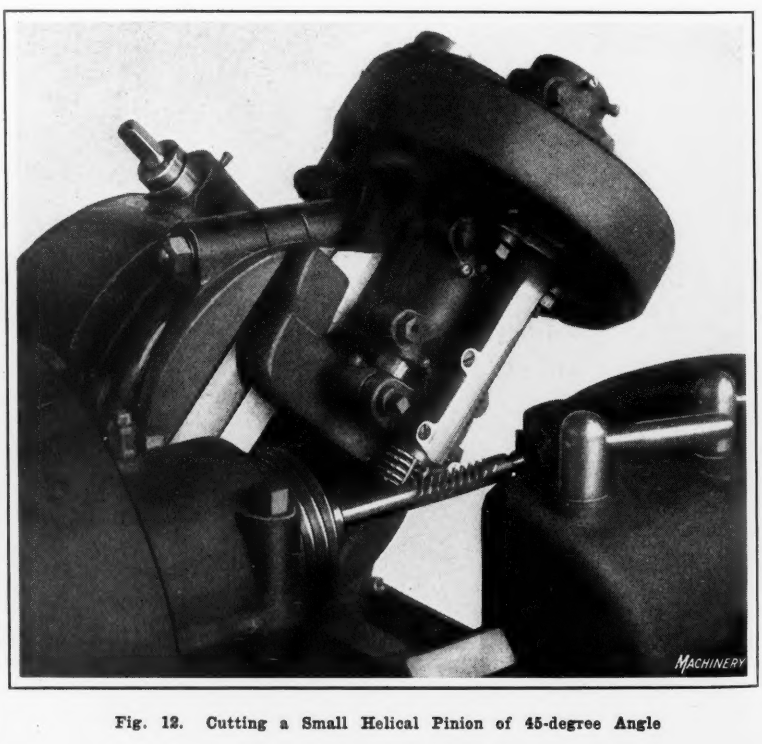


Fig. 12. Cutting a Small Helical Pinion of 45-degree Angle

angle. Fig. 10 shows a Farwell machine hobbing helical gears having a 70-degree angle. Other gears of 20-degree angle are shown on the base of the machine.

The hobbing of an automobile timing gear on a Brown & Sharpe machine is shown in Fig. 5. The gear is held rigidly between two heavy disks or plates, which extend out as far as possible without interfering with the hob. These gears must be cut very true, and all chattering eliminated, so that a rigid support is essential. On this machine the slide carrying the hob feeds along horizontal ways of the main bed (instead of feeding vertically, as on the other machines previously referred to) and the work-spindle is horizontal.

Examples of work on Lees-Bradner machines are illustrated in Figs. 11, 12 and 14. Another automobile timing gear job is shown in Fig. 11, two gears in this case being cut together. This machine is another design having a horizontal work-spindle; the feeding movement, however, is not applied to the hob-carrying slide but to the slide that supports the work. The small left-hand helical pinion, Fig. 12, has six teeth of 12 normal diametral pitch, a 45-degree angle, a pitch diameter of 0.707 inch. The cutting time for this job is 3.6 minutes. The machine illustrated in Fig. 14 is engaged in hobbing a gear of steep angle, the teeth inclining considerably relative to the axis.

Fig. 15 illustrates a method of holding a helical gear blank on a Lees-Bradner machine. The diameter of this blank is 6 inches, and the width ¾ inch. As the hole in the center of the gear is very small, the arbor is used for centering purposes only. The gear is clamped by the rim between sleeve *A* and plate *B*. The bolt holes in this clamping plate (see end view) have a key-hole shape, so that the plate may be removed by simply turning it about 30 degrees. This arbor provides a very solid, accurate means of supporting the gear, and is not subjected to stresses due to tightening the clamping nuts. The small end of the arbor is supported by the machine center, and the opposite end has a taper shank that is inserted in the machine spindle. A draw-in rod screws into the inner end of the taper shank.

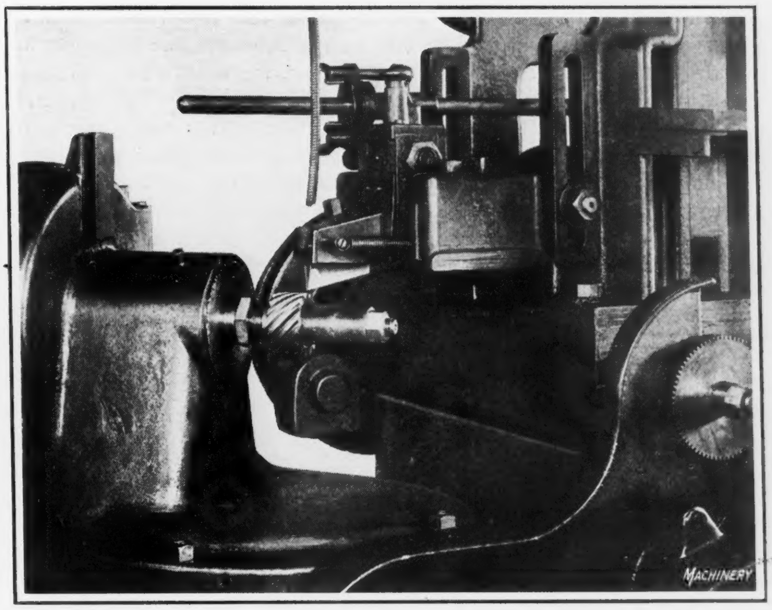


Fig. 13. Cutting Helical Gears on a Shaper of Horizontal Design

Cutting Helical Gears by Generating on Machines of Planer or Shaper Type

A Bilgram machine arranged for cutting helical gears is shown in Fig. 13. The action of this machine in cutting spur gears has been explained in a former article (see April, 1922, MACHINERY, page 646), and it operates on the same principle when cutting spiral gears. The motions for generating the spiral teeth may be compared with the well-known Sellers drive for planers. Thus, the gear being cut represents a spiral pinion, and the tool corresponds to one tooth of a rack. If the pinion were in mesh with a rack and revolving, the relative motions between the rack and pinion would be the same as the relative motions of the cutting tool on this machine and the gear being cut.

When the machine is at work, the gear blank indexes during each return stroke of the tool (which is lifted to clear the gear), thus bringing the next tooth space around to the cutting position. Inasmuch as the tool is slowly traversed laterally, the indexing movement is increased enough to compensate for this lateral travel, and all the teeth of a gear are formed while the tool passes from one side to the other. The traversing and indexing are controlled by change-gears. The work-holding head is set to agree with the helix angle of the gear being cut.

Fig. 14. Cutting a Helical Gear having Teeth of Very Large Helix Angle

The Fellows helical gear shaper generates tooth curves, but the action is different from the Bilgram machine just described. Instead of rolling the gear blank in contact with a tool representing a rack tooth, the cutter used resembles a helical gear and has a rotary movement in unison with the gear blank being cut, the principle of operation being similar to that of the shaper for spur gears. Fig. 8 shows one of these machines cutting a helical gear and operating, in this particular case, with a push stroke.

The cutter teeth have the same lead and pitch as the gear being cut, and as the cutter is reciprocated vertically it is given a twisting or turning movement so that the cutting teeth follow a helical path corresponding to the teeth of the gear. This turning motion is controlled by a positive helical guide made up of two main sections. One section is attached to the top of the cutter-spindle, and the mating guide is secured to the enlarged hub of a worm-wheel through which the cutter-spindle is rotated in

unison with the gear. This helical guide has the same helix angle as the gear to be cut, and a separate one is required if the machine is to be used for cutting a different helix angle.

This machine is intended for cutting gears of the same angle in large quantities and may be used continuously on one size of gear; then only one pair of helical guides is required, one being for right-hand and the other for left-hand gears. The cutter used for a right-hand gear has a left-hand helix. The work is withdrawn from the cutter on the return stroke by a relieving mechanism acting on

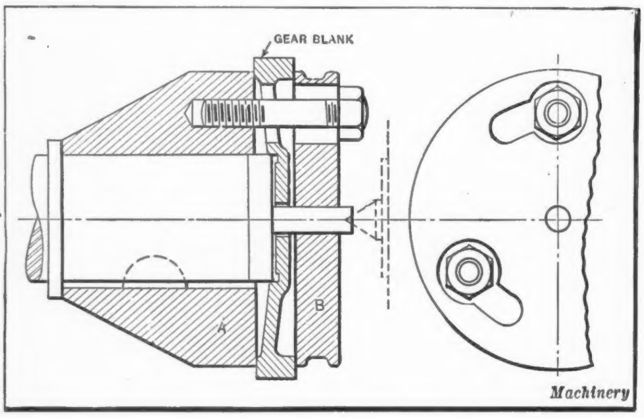


Fig. 15. Method of holding Helical Gear Blank on a Lees-Bradner Machine

the work-holding apron, thus preventing any dragging action over the tooth surfaces. In view of the fact that this helical gear shaper is similar to the spur gear shaper described in a preceding article, except for changes that give the cutter-spindle a helical or twisting motion, the machine itself will not be referred to in greater detail here.

* * *

CUTTER GRINDING ON A PRODUCTION BASIS

By DONALD A. HAMPSON

It is seldom that more than one cutter or one set of duplicate cutters can be ground without readjusting or changing the grinding machine set-up. Frequent changes in the set-up are made necessary by the variety of cutters used and by the change in form that every cutter undergoes when subject to wear. Under these conditions it is not surprising that but few manufacturers have attempted to place their cutter grinding on a production basis or to consider it in the same light as regular production work.

In small well-organized plants one skilled workman, provided with a cutter grinding machine of the universal type, may be able to handle all the cutter grinding, while in the larger plants several workmen operating a variety of cutter grinding equipment may be required. In the latter case, it is an advantage to give all the cutters of a certain kind or type to one man, those of another type to the next man, and so on. With this plan, the total number of changes in set-up made by each workman will be considerably less than if the cutters were given out indiscriminately. A further saving in time can be made if the cutters of each type are grouped according to size, so that as many cutters as possible can be sharpened without materially changing the grinding machine set-up.

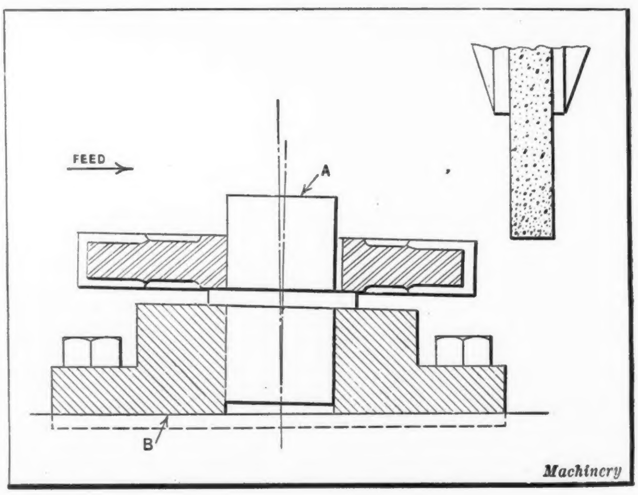
The standardization of taper shanks and threaded arbors will generally prove a distinct advantage. It should also be borne in mind that two sizes of milling machine arbors are generally sufficient for ordinary purposes, the sizes usually employed being 1 and 1½ inches in diameter. The use of more than two sizes of arbors lessens the degree of interchangeability of cutters and requires more equipment for the cutter grinding machines. It also results in an unnecessary waste of time in changing set-ups.

The advantage of having all cutters in duplicate, when possible, should not be overlooked. This is an important factor, not only from the milling machine production viewpoint, but also from the viewpoint of efficiency in cutter grinding. In many cases it is simpler and quicker to make an out and out change in the grinding machine set-up than it is to make the various adjustments necessary in using the universal type of cutter grinding fixture.

It is possible in many cases to put cutter grinding on a production basis by replacing the universal type of fixtures, which require many adjustments and "cut-and-try" methods, with simple grinding fixtures of the type illustrated. It will be noted that the cutter-holding arbor is tilted at an angle to give the correct clearance or taper to the sides of the cutter teeth. This particular fixture is designed for use in sharpening straddle milling cutters. Bushings may be used to adapt this fixture for holding cutters having arbor holes of different sizes. A tongue on the base *B* locates and holds the fixture in place on the grinding machine table.

In making a set-up with the fixture shown, the operator first clamps the base *B* in place on the table and puts the cutter over the post *A*. The grinding machine table is then locked and the correct indexing finger inserted. There is no chance for error in setting up this fixture, and the sharpened cutters will have an exact predetermined side clearance. Fixtures made on this principle can be used for nearly all kinds of milling cutters, on grinding machines that are equipped with either cup or plain disk grinding wheels.

When a surface grinding machine or, in fact, any type of grinding machine is used for cutter grinding, the adjustable members that are required to be in fixed positions during the grinding operation should be firmly set in place by taper pins. In short, the arrangement should be such that the machine can be changed from one set-up to another with the least possible number of adjustments. Ordinarily



Fixture for Use in grinding Straddle Mills

the change in set-up should affect only the index-finger, work-holding fixture, and head or bed of the machine. The only additional adjustment left for the workman is that of bringing the cutter into proper contact with the grinding wheel.

* * *

Stainless steel has been found quite suitable for several purposes in internal combustion engines. Inlet and exhaust valves are now made from this material, and in at least one case it has been employed for piston-rings and for the bolts and nuts of exhaust pipes and mufflers. Stainless steel is a cobalt-chrome alloy which is less susceptible to corrosion when subjected to extreme temperatures than other steels. The best results are obtained when the objects made from it are polished to a very high degree.

Knuckle-joint Embossing Presses

By N. T. THURSTON

KNUCKLE-JOINT power presses are used extensively for embossing coins, medallions, and other intricate forms, as well as for lettering or embossing that requires a large amount of pressure for a comparatively short time. Because of their use for this class of work these presses are often termed "coining" presses. There is a demand for many different sizes, and consequently these machines are built in over-all heights of from 5 to 20 feet, weighing from 6000 to 150,000 pounds. The smaller sizes are not geared, while the largest are double-geared and are reinforced with vertical tie-rods shrunk in place to insure strength and rigidity. The way in which these tie-rods are used was described in the article "Utility of Single-action Straight-sided Presses," which appeared in February, 1922, MACHINERY.

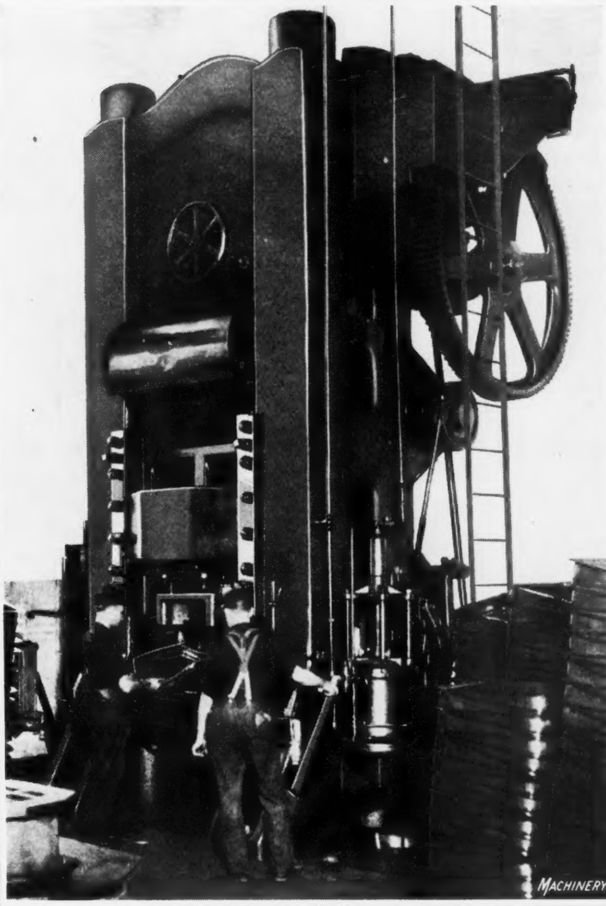


Fig. 1. Knuckle-joint Press forming an Automobile Frame Connection

In the knuckle-joint embossing press, the slide is operated by two knuckle arms, the upper end of the top arm being attached to a bearing held stationary in a vertical plane by the frame. The knuckle arms are actuated by a crankshaft at the rear of the press, which is connected by a link to the joining ends of the knuckle arms. By this arrangement the arms are moved in and out relative to the frame as the crankshaft revolves. When the arms are straightened, the slide is forced down with a constantly increasing pressure on the work until the end of the stroke is reached. The increasing pressure is due to the fact that as the knuckle arms are straightened, the vertical movement of the slide is small, compared with the horizontal movement of the knuckle. The longer the knuckle arms, the greater the difference in the two movements near the end of the stroke, and consequently the greater the pressure exerted. When the knuckle arms are pushed out as the crankshaft completes a revolution, the slide is again raised.

While an enormous pressure is exerted by the knuckle joint embossing press, this pressure is unlike an equal force obtained from the impact of fast-acting machines, such as drop-hammers and other types of power presses. In comparison with other power presses, the knuckle-joint press gives a force similar to a squeeze, as distinguished from a sharp blow. It is this slow increasing pressure that distinguishes the knuckle-joint press from other types. Such a pressure enables the metal to flow under the force of the punch, and fine intricate embossing is possible. An equal pressure in the form of a sharp blow would not give the metal the same opportunity to enter the delicate markings of the die, and for this reason a slower pressure is essential. It allows the metal to form over sharp edges and into curves, where a quicker-acting force would cause it to crack and tear.

A 2500-ton double-geared knuckle-joint embossing press in operation on the frame connection of an automobile is illustrated in Fig. 1. This operation forms the inner edges of the part upward. The stock is hot-rolled pickled steel, 3/16 inch thick. The slide is shown in position near the top of the stroke, with the arms of the knuckle brought close together, and it will be seen that the joint extends out from the press like a crooked finger. When the joint is in this position, the press has comparatively little power. The handwheel directly above the knuckle is used for adjusting the position of the slide relative to the bed of the press. The range of adjustment is slight, being only a few inches. An electric motor mounted on a bracket at the top of the machine is direct-connected to the pinion of the first set of gears.

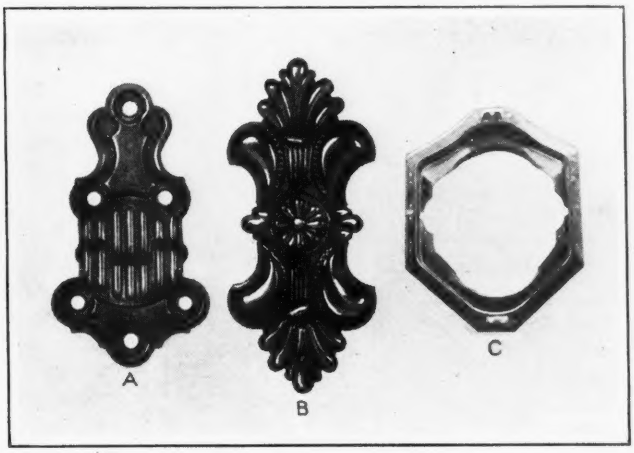


Fig. 2. Examples of Intricate Work produced on Knuckle-joint Embossing Presses

At the right-hand side of the machine is a compressor belonging to an equipment used to exert hydraulic pressure on the water expansion dies with which the press is provided. The small gear just below the large driving gear is also part of the hydraulic equipment, and causes the press to stop at the bottom of the stroke long enough for the water pressure to be exerted on the part being formed. Then, when the operator again trips the press, the slide is raised to the top of its stroke, where it is stopped by the gearing. The operator is able to control the press at any point in

the stroke by means of a hand-lever connected to a friction clutch at one end of the driving shaft.

The three parts shown in Fig. 2 are representative of work done to the best advantage by knuckle-joint embossing presses of various sizes. The part at *A* is a hinge pressed from 3/16-inch sheet brass. The blanking, piercing, and curling of the hinge are done in inclinable presses, and the forming and embossing are done in one operation on a knuckle-joint embossing press. The ornamental drawer plate shown at *B* is a still more intricate piece. This part is embossed, without annealing, in one operation on a knuckle-joint press. Although these parts require sharp and distinct lines, the finest type of work performed on presses of this type is the coining of money. On a silver dollar the metal is forced into impressions of hair-line depth, and an enormous pressure is required for a very limited portion of the stroke. The work of knuckle-joint presses can often be fed to the die from a hopper and automatically removed after the operation. By such an arrangement high rates of production are possible without danger to the operator.

This article was written in collaboration with the Acklin Stamping Co., of Toledo, Ohio.

* * *

TWO DRILL JIG DESIGNS

By EDWARD HELLER

Production costs were considerably lessened in the manufacture of two simple parts, by means of the drill jigs described in the following: The jig shown in Fig. 1 was designed to facilitate drilling the ⅛-inch hole in part *A*, in the proper location relative to the shoulder. This part is produced in a screw machine from ¼- by 11/64-inch stock; in this operation the large end is left square and rather rough. The jig consists mainly of a cold-rolled steel body *B*, bushing plate *C*, drill bushing *D*, clamp *E*, and clamping screw *G*. The bushing plate is doweled to the body so as to maintain the required distance *Y*, and is held to it by means of machine screws. Clamp *E* is held in a recess in body *B* by means of pin *F* upon which it is free to slide up and down.

When loading work in this jig as indicated by the heavy dot-and-dash lines in the plan view, clamp *E* is held in the lowest position. The clamp is then raised by lifting the head of screw *G*, and a slight turn is next given to the screw so as to tighten the clamp on the work and push it against the locating face of the body. The work is now ready to be drilled, after which screw *G* is again loosened to let the clamp drop down. The finished part is then pushed out of the jig from the back and a new piece inserted.

The jig in Fig. 2 was designed for use in drilling the eyebolt shown at *A*. This eyebolt is produced in a screw machine. A straddle-milling operation follows the screw machine work and brings the bolt to the form illustrated, except for the hole. As the hole is rather large for the amount of metal surrounding it, the jig was designed with a V-block which locates the work from the outside of this

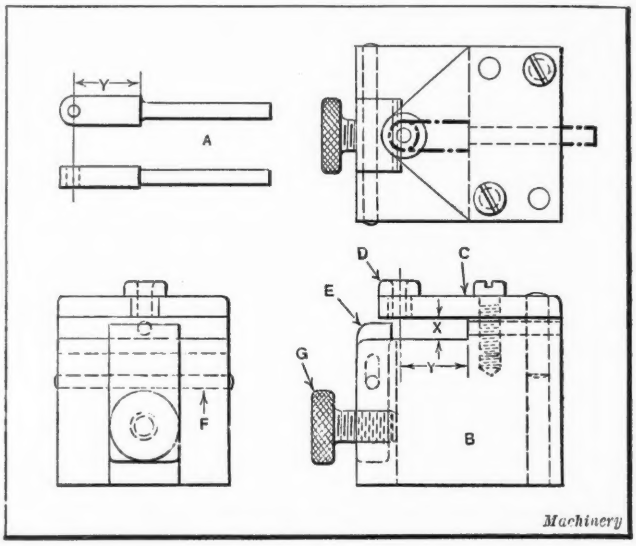


Fig. 1. Jig designed for Use in drilling the ⅛-inch Hole in Part A

end and insures that the hole will be drilled central with respect to the end.

In loading the eyebolt in this jig, push-rod *B* is withdrawn by pulling on screw *C* and swung at right angles to the position it occupies in the illustration. Bearing *D* swivels to permit this. The shank of the eyebolt is next inserted in hole *E* of the push-rod, after which the latter is swung back again and pushed forward to bring the head of the eyebolt in contact with V-block *F*. The V-block is held between bushing plate *H* and body *J*. When the work has been brought against block *F*, the screw is given a slight turn, which causes its conical point to force pin *L* upward against the bearing surface of swivel *D*. This is occasioned by having the spot in the pin drilled slightly above the center line of the screw. The movement of pin *L* serves to lock the push-rod in position (for a more detailed description of the pin action, see the article entitled "Adjustable-plunger Stops for Fixtures," which was published in October, 1922, MACHINERY). By this arrangement no undue pressure is exerted on the eyebolt.

After the operation, screw *C* is loosened and rod *B* is withdrawn and swiveled to permit replacement of the work. In case the eyebolt sticks between the bushing plate and the body, it may be forced out by pushing against the outer end of knock-out rod *M* with one hand. The spring on the knock-out rod normally holds the opposite end in a recess in block *F*.

There is one point that should be observed in designing jigs of the type described; width *X*, Fig. 1, of the slot in which the work rests and the thickness of V-block *F*. Fig. 2, should be about 0.010 inch greater than the thickness of the work. This allowance should be proportioned in the ratio of about 4 to 6 above and below the work, respectively. Both jigs were designed for drilling about 4000 pieces. If the required production had been larger, it might have been advisable to provide a tool-steel button at the point where the drill comes in contact with the body of the jig.

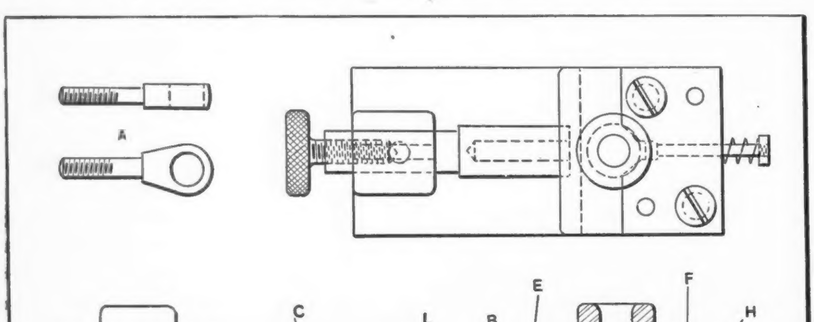


Fig. 2. Design of Jig which insures Proper Location of the Hole in Eyebolt A

Making Gears on the Punch Press

By FRANK LUX

THE punch press offers one of the most economical methods of manufacturing certain classes of gears when the work is of a suitable size and design. The rapidity with which work can be produced in this way is remarkable. Most manufacturers of adding machines, typewriters, cash registers, etc., make the gears entering into the construction of their product by this method. Not only is the punch press one of the cheapest machine tools to operate, but when compared with a gear-cutting machine, its upkeep is also much less. Thus gears may be produced on the punch press at a fraction of the cost involved by other methods.

The main initial cost in setting up a press for producing gears is the expense of the dies. However, a well designed and properly constructed set of dies will produce over 100,000 gears, provided the material from which the gears are punched is not hard enough to cause the dies to wear rapidly. The labor cost of operating punch presses is very small. In considering the adaptability of a product to this manufacturing method, there are three points to be analyzed: (1) The material from which the gears are to be produced; (2) size and design of work; and (3) accuracy required.

Three Factors Governing the Adaptability of Gears to Punch Press Manufacture

The most suitable materials from which gears may be punched are good grades of punching steel, which generally run soft, medium, or hard. Soft steel, as a rule, is likely to tear in punching, with the result that the gears have rougher edges than when produced from medium or hard steel. On the other hand, if the material is too hard, there is difficulty in maintaining the cutting edges of the punch and die. However, the material to be punched may be annealed before stamping and rehardened after the operation. A cast-iron gear cannot be successfully machined by means of dies, and neither can brass nor aluminum castings, even though both brass and aluminum flat or strip stock can be blanked satisfactorily.

It is impossible to give hard and fast rules regarding the maximum size of gears that can be produced; this must be decided mainly from experience. In the opinion of the writer, the maximum thickness of metal that can be successfully punched ranges from 5/16 to 3/8 inch, the exact thickness depending on the over-all diameter of the gear. It is

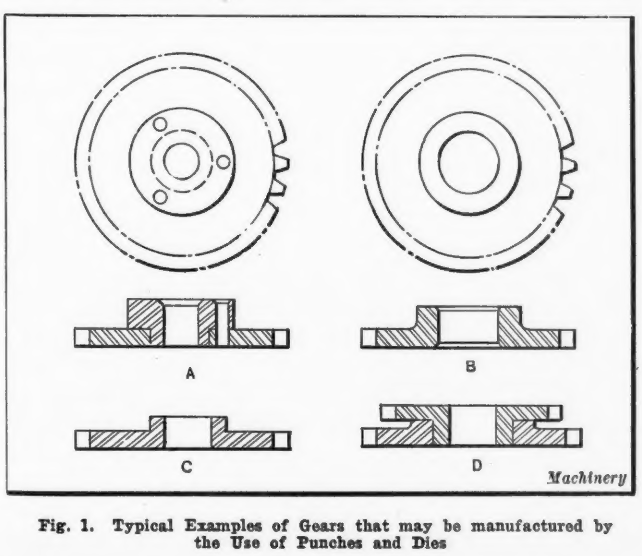


Fig. 1. Typical Examples of Gears that may be manufactured by the Use of Punches and Dies

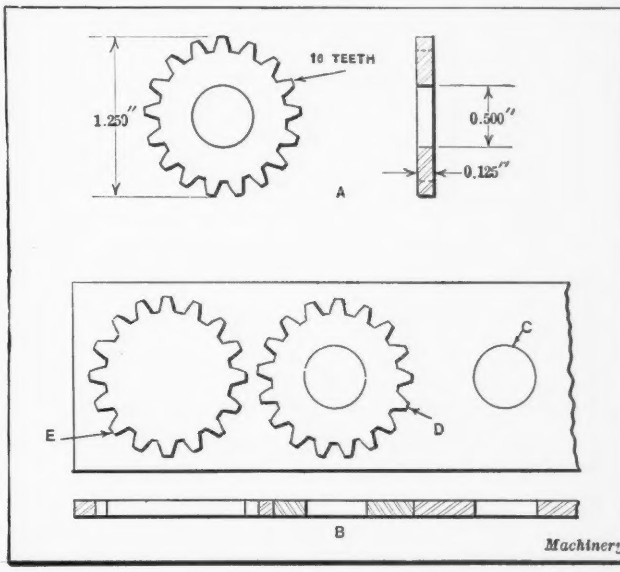


Fig. 2. (A) Gear for which Dies were designed; (B) Appearance of the Stock as it is fed through the Blanking Die

possible to obtain smooth and uniform teeth with metal of a thickness up to this maximum range.

The pitch of the teeth does not have to be considered to any great extent; however, it is best not to attempt to blank gears, say, 3/8 inch thick, having fine-pitch teeth, because the load on the punch and die would be likely to strip the teeth. The size of the hole in a gear also determines the possibility of producing the work in a die. It would not be advisable to attempt to produce a gear of say, 24 pitch, 1 inch diameter, 1/4 inch in thickness, having a 5/8-inch hole at the center, because experience shows that the pressure applied when blanking, would twist the gear out of shape, and would cause the cutting edges of the punch and die to become rounded.

As it is possible to maintain accurate limits on die work, not much trouble is encountered in manufacturing gears to the required accuracy by this method. The greatest difficulty in maintaining accuracy arises from the material that is used. There is generally a difference in the hardness of the stock, and this affects the size of the blank to a certain extent. However, the variation is small, and in most cases the size will be within the required limits of accuracy. If the important dimensions of a gear are held to a tolerance of 0.0005 inch, the gear can be successfully produced. It is, of course, necessary to regrind the faces of the punch and die occasionally in order to produce the work within the required limits. The average tolerance specified on punched gears is about 0.001 inch.

Cost of Punching Gears

After it has been determined that a gear may be satisfactorily produced by the punch press, it must be estimated whether the quantity to be manufactured will be sufficiently large to warrant the expense of making a set of dies. Obviously, it would not be advisable to construct dies for a comparatively small quantity of gears, because the cost per part would probably be prohibitive. The approximate cost per piece of producing gears on a punch press may be determined by dividing the cost of the die by the estimated number of parts which can be produced by it, and adding the labor and overhead costs.

For example, if a gear such as shown at *A*, Fig. 2, is to be produced in 100,000 lots, and the set of dies costs $1000, the tool cost per piece is one cent. Now, assuming that a time study shows that a gear can be produced in one minute, and allowing 90 cents per hour for labor cost, the labor cost per gear would be 1.5 cents. An allowance must also be made for the cost of regrinding the punch and die faces as they become dull, and assuming that ten regrinds at $2 each will be required in manufacturing the entire lot, the total cost for this item would be $20, or 0.02 cent per gear. Adding the three items, the total cost per gear, not including the cost of material or overhead charges, is found to be 2.52 cents. If the die is properly designed and made, the cost of repairs will not be worth considering.

Method of Production

The procedure in manufacturing gears on a punch press is to employ a progressive blanking die to blank the gear and pierce a hole through its center, and then use a shaving die to smooth the contour of the teeth and the hole to the required accuracy. Various styles of gears can be produced by means of dies, the most common form being a flat gear having a hole at the center but no projecting hub. Fig. 1 shows a number of typical examples.

At *A* is shown a flat gear having a hub fastened to it by means of three rivets. This hub is fitted into the gear blank after the blank has been finished. At *B* is shown a similar example with the exception that the hub is integral. In this case the hub is first produced on a screw machine, after which blanking and shaving dies are used to form the teeth and the hole. In some instances when a small-diameter hub is desired, it is possible to form the work from flat stock as shown at *C*. Gears of this kind are blanked, drawn, and swaged prior to the shaving operations. It is often necessary to assemble gears together, and at *D* is shown an example of this kind, the two gears having their hubs produced on screw machines. These gears are riveted together in a manner similar to that employed in attaching the hub to the gear in the example shown at *A*. In addition to these examples, other forms of gears, such as sectors, racks, etc., may be successfully produced by means of dies.

Design of a Progressive Blanking Die

In order to illustrate the method followed in designing a blanking die for punching gears, it will be assumed that the gear shown at *A*, Fig. 2, is to be produced from a medium-grade punching steel 0.125 inch thick. It will be further assumed that the required accuracy necessitates shaving 0.012 inch of stock from both the hole and the contour of the teeth.

The first step is to determine the width of stock required, and then make a lay-out, such as shown at *B*, which indicates the various operations performed by the progressive die. It will be seen that the center hole *C* of the gear is pierced first, a sufficient amount of stock being allowed for the shaving later. Teeth *D* are then blanked, after the stock has been moved sufficiently to the left to bring the center of the punched hole in alignment with the center of the punch used in blanking the teeth. The appearance of the stock after the gear has been removed is shown at *E*.

It is necessary to allow a width of stock between each blanked hole and the edges of the strip, about equal to the thickness of the blank. A similar amount of stock should be allowed between the blanked holes. In this instance, the strip must be 1 1/2 inches wide to provide the proper amount of stock between the blanked holes and the edges of the strip, and the center-to-center distance between the blanked holes must be 1 3/8 inches. The latter dimension makes it possible to determine the length in which the strips should be supplied in order to avoid unnecessary scrap loss.

In designing a progressive blanking die, particular care should be taken to obtain proper alignment between the punch and die members, because the life of the tools greatly depends upon this. Fig. 3 shows the progressive blanking die designed for producing the gear. The stock is fed through the die in the direction indicated by the arrow in the plan view shown in the lower part of the illustration.

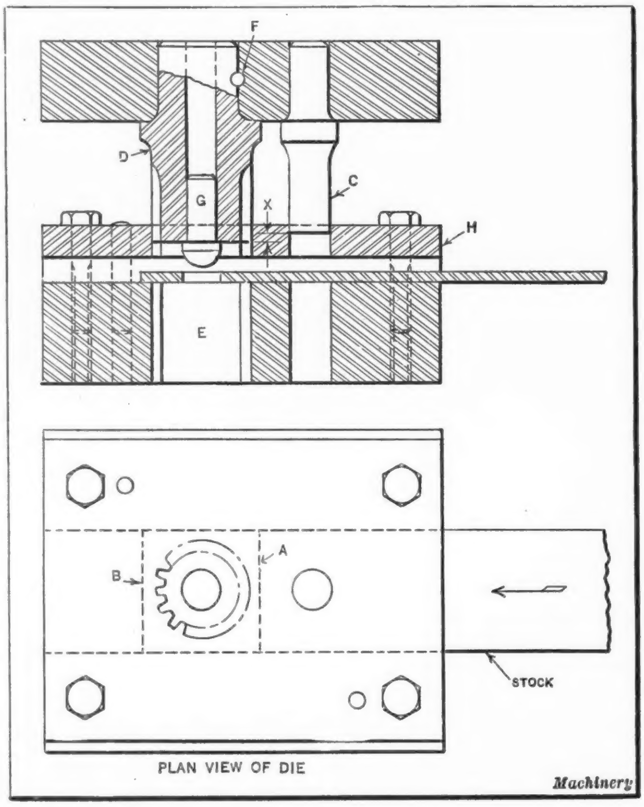


Fig. 3. Progressive Blanking Die which pierces the Hole at the Center of the Gear and blanks the Teeth

Before blanking the first gear, the strip is fed until the end reaches the point indicated by the dotted line *A*. The ram of the press is then brought down and the center hole of the gear pierced. The strip is then advanced until the front end reaches position *B*, when the press is again brought into action and the gear blanked out. From the sectional view it will be seen that the hole of the gear is pierced by a punch *C* attached to the same holder as the blanking punch *D*. The blanked gear falls through the opening in die-block *E*. Punch *D* has teeth machined on its lower end for producing the teeth on the work. This punch is held from turning in the punch-holder by pin *F*.

Locating the Stock for the Blanking Operation

In operation, the blanking punch passes through the stock before the piercing punch comes into contact with it. This will be obvious by referring to dimension *X* which is equal to the thickness of the stock. The strip is stopped at the right positions by means of a finger-stop, which is not shown because, in most cases, it is a standard equipment of punch presses. As there may be slight inaccuracies in the operation of this finger-stop, it is common practice to provide the blanking punch with a pilot *G* which fits into the hole previously pierced in the stock, and aligns this hole properly for the blanking step in case the strip has shifted out of place.

A stripper plate *H* is assembled on the die-block to prevent the blanked work from sticking to the punch on the upward stroke of the ram. Spacing plates support the stripper sufficiently above the die-block to permit passing the stock between the stripper plate and the die-block. The stripper and spacing plates are assembled to the die-block by means of four machine screws, after being doweled in the correct

alignment. The die-block is beveled on the sides and held in a shoe by means of set-screws. The punch-holder has a dovetail fit in a member attached to the press ram.

In making a die of this kind, the diemaker should be extremely careful to align all parts correctly, and so machine the teeth in both the punch and the die that these members will fit one another properly. These parts should be made from a good grade of tool steel, and the die should be of sufficient size to prevent spreading or cracking when it is being hardened. There is danger of this happening if sufficient stock is not left around the die opening. In the die illustrated, 1½ inches of stock is allowed all around the opening, and this is considered good practice for work of this size and shape. It would be possible to use a sectional die with each section taking in a certain number of teeth, but there is more danger of spreading and other troubles with a die of this kind than when the die is constructed from a solid piece of steel. The method illustrated of securing the punches to the holder is probably the best, although in some shops a large flange is provided on the punch instead of a shank, and the punch is attached to the holder by screws. Such a change in design need not alter the construction of the other parts of this die.

Amount of Stock allowed for Shaving

If a part produced in a punch press is carefully examined, it will be found that its edges are comparatively rough, due to the cutting action of the punch and die. In most cases the punch cuts the metal through about one-third of its thickness and the die cuts it the same amount. The remaining one-third at the middle is torn or sheared off. The result of this action may be clearly seen by examining the edges of a punched part through a magnifying glass. As a rule, the metal near the edge of the part on the side nearest the die is smoother than near the edge on the side next to the punch. In order to mesh properly, it is necessary for the gears to have smooth tooth faces. If they were used as they came from the blanking die, they would only bear at points close to the edges and would wear rapidly, resulting in considerable backlash and other inaccuracies.

The purpose of the shaving operation is to smooth the tooth faces, tops and roots, and the hole. It is generally found most satisfactory to perform this operation in two steps, but this depends upon the accuracy required, and in many cases only one shave is needed. The amount of metal removed by a shaving die should be proportionate to the thickness of the blank. With a medium-steel gear, 3/16 inch thick, which is shaved in one operation, the amount of stock removed should be about 8 per cent of the gear thickness, or 0.015 inch. If there are to be two shavings, it is necessary to allow 10 per cent of the thickness, taking off two-thirds of this amount in the first shave and one-third in the second.

The shaving operation must be performed on all materials, but the amount of stock removed varies with the kind of material. With soft steel, a smaller amount need be removed than with hard steel, and in shaving brass gears it is generally necessary to allow the same amount as for hard steel gears. The correct amount of stock to be removed is an important matter, as it is quite possible to remove too much on the first shave and produce surfaces practically as rough as the original blanked edge. Likewise, the deepest ridges will not be eliminated if sufficient stock is not removed. In many cases, gears properly shaved are smoother than those produced by milling, and have very good wearing surfaces.

A compound die designed to shave both the contour of the teeth and the hole of the gear illustrated in Fig. 2, is shown in Fig. 4. The work rests on blank-holder *A* as shown, being located by means of three nests *B*, which may be clearly seen in the plan view at the right. The nests are not shown in the sectional view. Two of these nests locate the gear by means of one tooth, while the third has two teeth. Besides providing a good means of locating the work, the nests hold it rigidly in position. The thickness of the nests should be somewhat less than that of the work; in this die, they are 0.100 inch thick, whereas the work has a thickness of 0.125 inch.

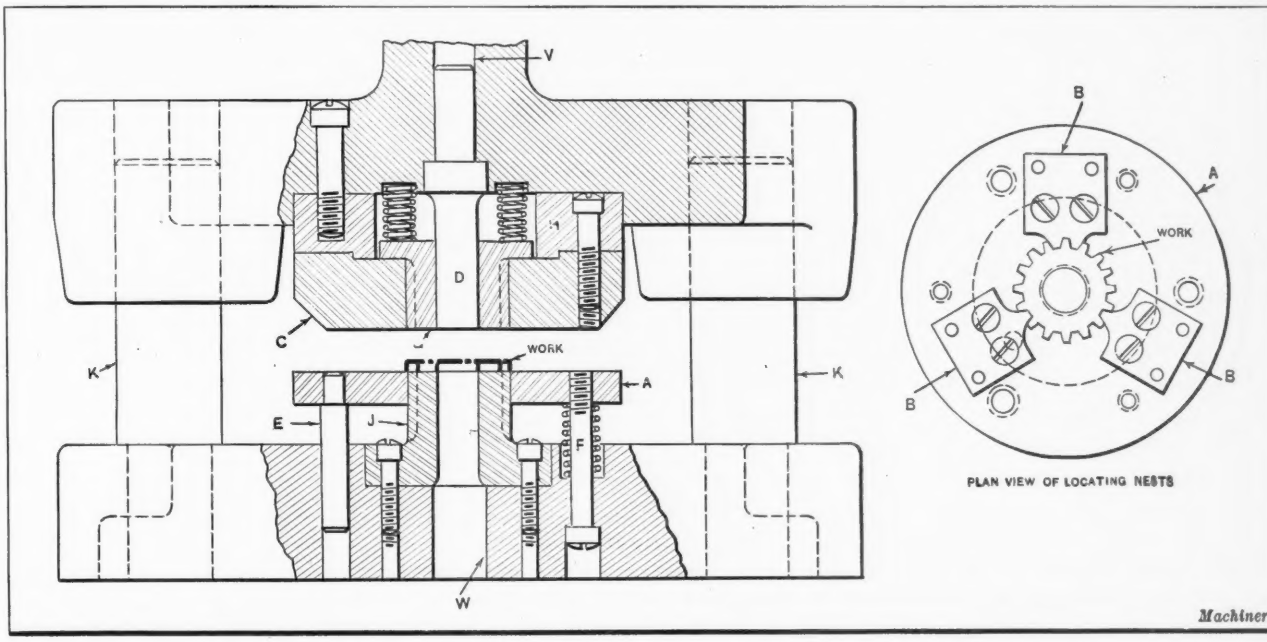


Fig. 4. Compound Die employed for shaving the Contour of the Gear Teeth and the Hole at the Center

Operation of the Shaving Die

The upper die *C* shaves the work on the downward stroke of the press ram. When this die reaches the nests it carries them and the blank-holder downward until the bottom of the stroke is reached. The hole in the work is shaved by punch *D* at the same time that the contour is machined by the die. The blank-holder is provided with three guide pins *E* which prevent it from buckling under the pressure exerted by the ram. The raised position of the blank-holder is controlled by means of three fillister-head machine screws *F*, the blank-holder being actuated on the upward stroke of the ram by coil springs around these screws.

Work sticking in die *C* on the upward stroke is removed from this member by ejector *G* which fits the center of the die and is forced downward relative to the die by means of coil springs. On the downward stroke of the ram the ejector remains stationary against the work. Die *C* is assembled

on a sub-plate *H* by means of a tongue and several fillister-head machine screws. This sub-plate, in turn, is fastened to the punch-holder by screws, after being properly aligned by means of a counterbored hole and dowel-pins. Block *J* is also located on the die-bed by means of dowel-pins and a counterbored hole, and is fastened by machine screws. The punch-holder is held in alignment with the die-bed by guide pins *K*.

A die of this type is not difficult to make and the alignment of the parts is comparatively simple, because all parts are round and easily assembled. Holes *V* and *W* may be drilled and reamed in the punch-holder and die-bed, respectively, by mounting the two units together on the faceplate of a lathe with the die-bed next to the faceplate, and then feeding the tools through both units. The punch-holder may then be removed and the die-bed counterbored to receive block *J*, after which the die-block may be removed from the faceplate and the punch-holder mounted on it to be counterbored for sub-plate *H*.

If these counterbores are carefully machined and the parts that fit into them are properly turned, little trouble will be experienced in aligning the parts. All working parts should be made of a good grade of tool steel and hardened. As die *C* and punch *D* become worn, they may be reground across the face, about 3/8 inch of stock being allowed for regrinding. The die used in the second shaving operation is of the same design as the one just described, but the dimensions of die *C* and punch *D* are such that a different amount of stock is removed from the work. The locating nests are also made to slightly different dimensions so as to accommodate the gear as it comes from the first shaving operation.

* * *

GEAR BLANK PATTERN FOR REPAIR JOB

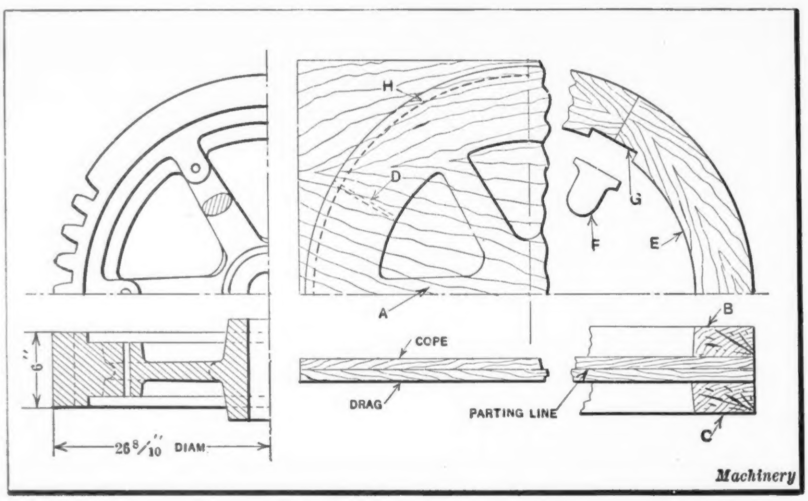
By M. E. DUGGAN

The master mechanic of a certain plant, in addressing the patternmaker, said, "I don't care how you make this pattern so long as the casting answers the purpose for which it is used, and we can get the machine started in the shortest time possible." Such instructions, when issued to an experienced patternmaker, invariably save time. They give him permission to eliminate all unnecessary refinements and make any changes in design that he has learned by experience will expedite the production of a serviceable casting. However, such latitude could not be allowed in all cases, for the inexperienced patternmaker might be at a loss as to how to follow such instructions or hesitate to take the responsibility of making any changes in the original design.

In this particular instance, a casting for a gear blank was required. The design of the gear to be replaced is shown by the upper and lower views at the left-hand side of the accompanying illustration. It will be noted that the rim of the gear is rounded and that the arms are tapered and oval in shape. All these refinements are in accordance with carefully worked out rules of machine design, but they are not necessary for the successful functioning of the gear and were therefore disregarded by the patternmaker.

The way in which the pattern was made should be of interest to all those who are likely to be called upon to make patterns for quick repair work. Nearly all the work was done on the band saw so that very little hand work was required.

The cope and drag section of the pattern were laid out to include the six arms and part of the hub and rim. The rim section of the gear was completed by two ring sections *B* and *C*, which were fastened to the sides of the arm sections *A*, as indicated in the lower right-hand corner of the illustration. Two boards dressed to one inch in thickness were used in making the arm sections. The outline of the hub arms, and rim was laid out on the top board, as shown. A band saw was employed to cut out the pieces on the full lines, sufficient stock being left on the outside diameter to permit sawing the pattern to the inner circle or dotted line *H*. The six openings between the arms were cut out and finished on the band saw by sawing through the rim as indicated by the dotted lines at *D*. Lumber 2 inches thick was dressed down to 1 3/4 inches for the rings *B* and *C*. Each of these rings was made in six segments, the segments being rough-sawed, glued, and fastened together to form a full ring.



Gear Details and Diagram showing Method of making Pattern for Gear Blank

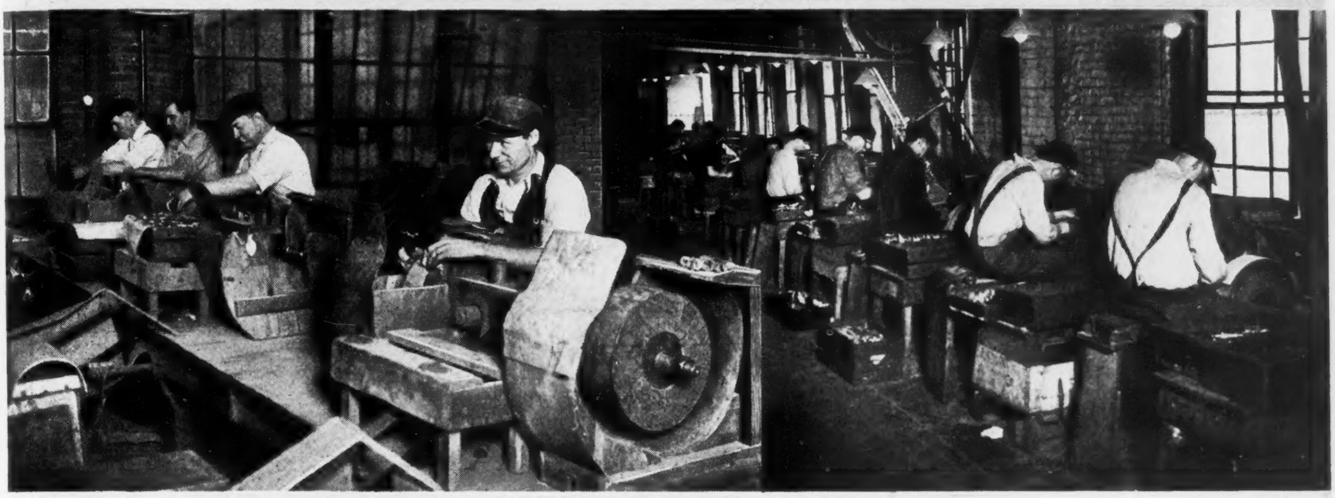
One joint in each ring was left open to permit the saw to be passed through the open joint for sawing or finishing the inside of the ring on the line *E*. For finishing this surface the table was tilted so that a bevel or draft of 1/4 inch was produced. The open joint through which the saw was passed was temporarily fastened during this operation. The slots *G* for the bolt pads *F* were sawed out with a band saw after setting the table back to the 90-degree position. The twelve bolt pads *F* (six on each side) were set in the recesses *G* and fastened in place. The circumference circle was struck on the top of the rim and cut in one pass of the band saw. The band saw was also used to cut the hubs to shape. The drag hub was fastened to its respective arm section and the cope hub left loose. The whole pattern was given a rough finish with coarse sandpaper.

* * *

LARGE TESTING MACHINE

What is said to be the largest testing machine in the world has recently been installed at the Bureau of Standards, Washington, D. C. The machine is capable of exerting a crushing force equal to the weight of fifty loaded coal cars of one hundred tons each. It is to be used in testing specimens for the towers of the Delaware River bridge now under construction at Philadelphia. The machine has two massive heads, one set in a concrete foundation beneath the floor, and the other supported on four steel screws, each over a foot in diameter and two stories high. The specimen to be tested is placed in the machine by an electric crane capable of lifting twenty tons. The upper head is brought down until it rests on the specimen, and the load is applied by a huge hydraulic jack, built into the lower head. Measurements are usually made of the shortening of the column under load, and when it crushes the broken pieces are studied to find the reasons for failure and the method of making stronger columns.

Polishing Room Arrangement



By BRADFORD H. DIVINE, President Divine Brothers Co., Utica, N. Y., and President of the Metal Finishers' Equipment Association

THE previous articles in this series on polishing methods have dealt with the general principles involved, glue used for polishing wheels, types and classes of polishing wheels and the methods by which the different styles of wheels are made. The subject dealt with in this article relates to the arrangement of polishing departments.

The Glue Room of a Polishing Department

Fig. 1 shows the lay-out of a polishing department. To the left are shown the glue room where the wheels are set up and made ready for use, and the wheel drying room where the wheels remain after setting up until they are used. To the right is the polishing room, where the work of polishing is performed.

The process of preparing polishing wheels by charging their surfaces with abrasives held by glue is known as "setting up." This setting up, which has to be done on new wheels, and continually on wheels in use, is performed in the glue room, which should be separated from the polishing room, as shown in the illustration. The glue room should be well lighted, and while it should have sufficient ventilation, it should at the same time be so arranged that there will be no drafts from doors and windows, as the slightest draft on the glue in the setting-up process will chill and injure it.

A very satisfactory method of securing ventilation is to build up the partitions to a height of about nine feet from the floor, leaving a space open from the top of the partition to the ceiling, and openings at the bottom of considerable size so that the air may enter at the bottom freely and pass out at the top. (See Fig. 2.) If it is necessary to open windows, deflectors should be provided as shown at the right to direct the air upward and permit it to enter the room easily without creating a draft which would strike the glue or wheel in the process of setting up. All doors should be of the double-swing type, which will close automatically. The glue room should contain all the equipment necessary for the setting up of wheels and should also have provisions for the storage of the materials used and for the drying of wheels that must be dried in an oven, as mentioned later.

Referring to Fig. 1, the storage for glue is shown at *A*; the glue heater, which is kept at a temperature of 150 degrees F., at *B*; the abrasive troughs in which the wheels are rolled after glue has been applied to the surface, at *C*; and the storage for abrasives, at *D*. The abrasive troughs are provided with steam coils for heating the abrasives to about 110 degrees F. They are made 6 inches wide by 6 inches deep by 6 feet long, and are set directly on the floor. The troughs should be provided with hinged covers to prevent coarse abrasives from becoming accidentally mixed with finer abrasives, a condition which ordinarily is not noticed until the wheel is put into action, when scratches will be found on the polished surfaces.

At *E* is shown the wheel-heating oven, the construction of which is shown in greater detail in Fig. 3. This oven may be made of either galvanized iron or wood; it contains two compartments, one for heating the wheels before setting up, and the other for drying the wheels after they have been set up. It is kept at a temperature of 110 degrees F.

The drying oven is not intended for permanent use every day in the year, but rather as an emergency outfit for use on winter days in the morning before the drying room has reached its normal temperature of from 60 to 75 degrees, or in summer weather when the humidity is very high and when evaporation is slow. It is always better for glue to set in the normal atmosphere of the factory, than to apply the use of direct artificial heat.

The Wheel Drying Room

The wheel drying room should be located so that it is easily accessible, both from the glue room and the polishing room. If the wheel drying room is to be built into an already established room, the partitions should preferably be of glass, and like the partitions for the glue room, there should be a liberal opening between the floor and the bottom of the partition and between the top of the partition and the ceiling to provide proper circulation of air. All the doors leading to or from the wheel drying room should be double-swing doors, which will automatically remain closed and prevent drafts.

There are several methods of conserving spa _ in hanging wheels in a wheel drying room. A good method is to place 6-inch square posts in the room, far enough apart so that there is plenty of space to pass between the posts in order to put up and take down wheels. Holes should be

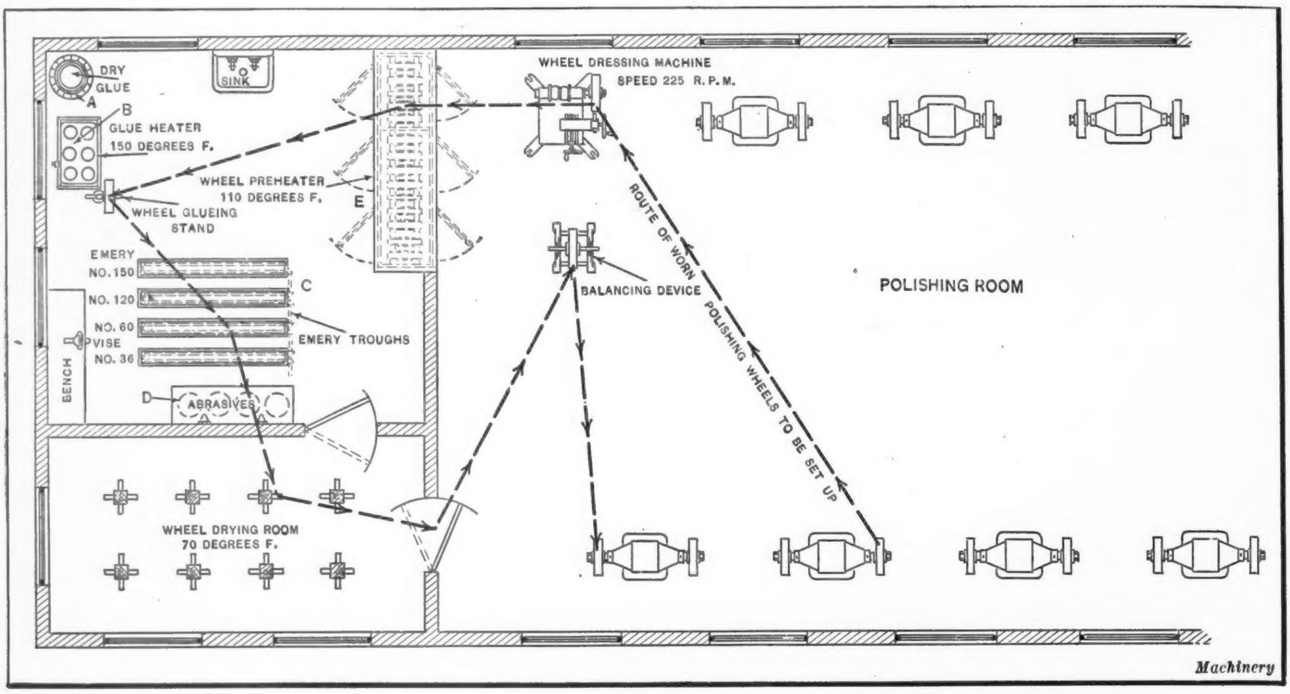


Fig. 1. Lay-out of a Polishing Department with Facilities for treating Used Polishing Wheels

drilled in the posts to receive ½-inch pipe or iron bars that should extend through in both directions. These pipes or bars may be of any length, depending on the number of wheels it is desired to hang on each support. Slatted iron racks are often used so that the wheels may lie flat on them, the purpose of the slats being to permit air circulation.

Some concerns have followed the practice of using two parallel iron bars which are placed at an angle to each other, forming a shallow trough open at the bottom, in which the wheels are placed on their faces, as shown in the upper right-hand corner of Fig. 3. Sometimes only two parallel round bars or pipes are used. The objection to this kind of rack, however, is that if a wheel freshly set up is placed on it so that the wheel rests with its polishing or grinding surface on the pipes or iron bars, the face, especially if the wheel is heavy or large, is likely to be marred by dents or depressions. In the wheel room there should be a permanent location for wheels of different sizes, wheels used for different purposes and wheels having different abrasives, each location being plainly marked. The arrangements will, of course, depend upon the size of the room and the number of wheels in use.

If the locality is near the seashore or where high humidity or excessive dampness is likely to prevail, it may be necessary to install one or two lines of pipe from a heating system along the walls of the wheel drying room. Then, when the room is damp, enough heat can be turned on to dry up the moisture. Care should be taken, however, not to overheat the room, as this will cause the glue on the wheels to crack or shrink. The temperature should preferably be kept around 70 degrees F. Dryness is what is required in a wheel room, not heat.

The Wheel Preheater

The preheating compartment *E*, Fig. 1 (also shown in Fig. 3) is heated to 110 degrees F. Preheating of the wheels is necessary to prevent sudden cooling of the glue when it is applied to them. If the glue is suddenly cooled from the

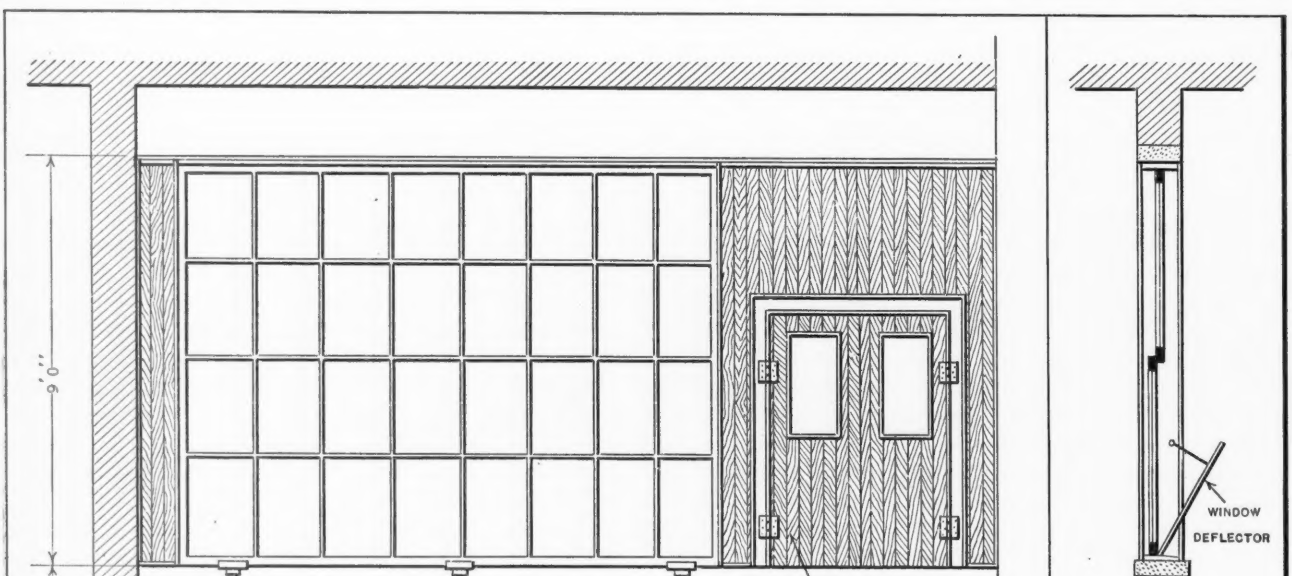


Fig. 2. Partitions for Glue Room and Wheel Drying Rooms, and Deflector for Windows

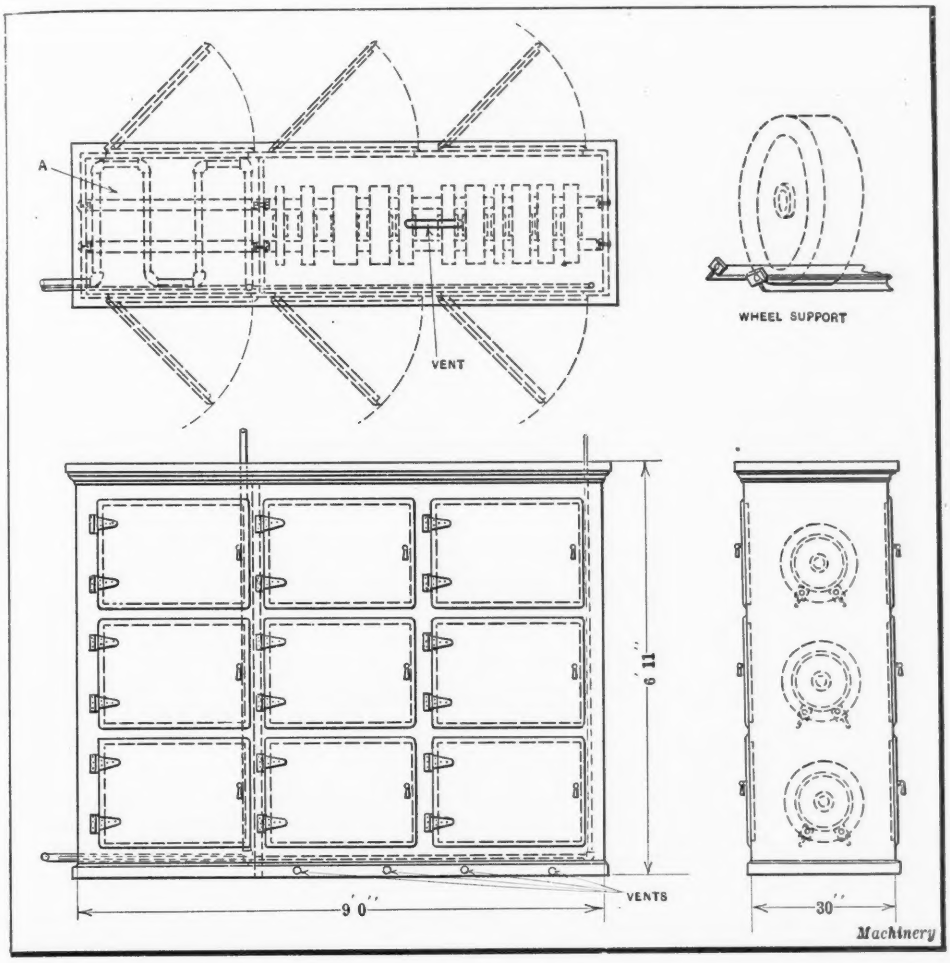


Fig. 3. Oven with Compartments for preheating Wheels before setting up, and for Wheel Drying

of setting, without requiring the operator to waste time waiting for it. The extra wheels permit plenty of time for the glue to dry, and the investment necessary is far less than the waste of time, glue, and abrasives, to say nothing of the poor quality of the work done, when using wheels that are too green. On the other hand, there should not be so many wheels that they cannot all be used in rotation within seventy-two hours after they are ready. This is especially true during damp weather, because if allowed to stand over a long period, the glue will absorb enough moisture to make it work badly. If this method is followed carefully, and the best materials are used, no trouble will be experienced in the glue not holding the abrasive properly, and the best results will be obtained from the glue and abrasive.

In some plants the operators set up their own wheels. This is poor practice. When the volume of the work permits, the care of the wheels should be entrusted to one man who has charge of all the facilities and equipment for the setting-up process. When the glue room is in charge of one man, he will soon become an expert in setting up and taking care of the wheels, with the result that all the wheels will be uniform. Uniform wheels will give uniform production and, furthermore, by keeping the polishers constantly at work, the extra profit on the increased production will in most plants more than pay for the wages of the wheel man. This is especially true in large plants. The setting up of polishing wheels should be so standardized that the wheels can be passed out to the operators the same as tools from tool-rooms. This applies particularly to concerns that may be crowded for room,

temperature of 150 degrees F. at which it should be kept while heated, it loses a great deal of its holding power and shrinkage cracks develop across the face of the wheel. Currents of air striking the hot glue while it is being applied to the wheel have the same effect. The proper way of handling glue was described in the article "Properties of Glue for Polishing Wheels," published in October, 1922, MACHINERY.

The heating oven, or preheater, has swinging doors on both sides so that the wheels from which the old "head" (the coating of glue and abrasive on the polishing wheel) has been removed, may be passed in from the wheel dressing machine in the polishing room directly to the preheating compartment, and removed on the other side; they can then be taken directly to the gluing stand where the heated wheel is immediately set up with a new head, without danger of the glue becoming seriously chilled.

The heated wheel and abrasive will hold the heat longer than the liquid glue, and the glue will soon assume the temperature of the wheel and the abrasive, the whole mass cooling gradually together. Although the abrasive feels cold to the hand in a short time, the setting and solidifying action of the glue requires fully forty-eight hours. After thoroughly setting, the wheels should be removed, when required for use, from the drying room or drying compartment and balanced in the polishing room.

General Methods of Setting up Polishing Wheels

Enough wheels should be provided so that each wheel will have fully forty-eight hours

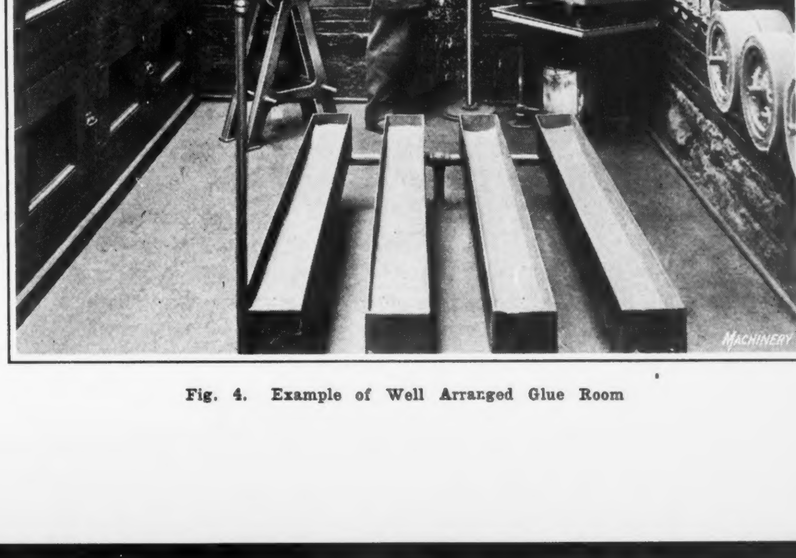


Fig. 4. Example of Well Arranged Glue Room

where the extra production may be secured as described, without putting in extra machines and polishers, thus saving both space and the cost of new equipment.

If artificial abrasives are used, the grain should be well rolled into the glue until the surface presents a packed appearance. Artificial abrasives do not become packed or embedded into the glue as readily as emery. The man in charge of the glue room will soon realize this fact, and will take the necessary precautions and care when artificial abrasives are used. Although it is not practicable to lay down specific instructions for the preparation of polishing wheels, because each case requires particular attention, it is possible to standardize to a large degree the equipment used, so that a more uniform procedure can be followed in all polishing departments.

The diagram Fig. 1 shows the route that a wheel follows from the time it is removed from the polishing lathe until it is remounted, and also shows what may be considered a standard arrangement for handling the setting up of polishing wheels. It was prepared by the engineers of Divine Brothers Co. with a view to showing a typical, well arranged polishing department with the necessary equipment. The glue room installation shown in Fig. 4 is part of the polishing department of the International Heater Co., Utica, N. Y., and is similar in its general arrangement to that shown in Fig. 1, but is laid out to suit the space available. Extra wheels are hung on pegs in readiness to be set up. The heated abrasive troughs are shown in the foreground, and the balancing equipment with a wheel in place may also be seen. The preheating and drying oven are shown at the left, and the glue heater and wheel stand in the far right-hand corner. A hood is provided for the glue heater, to remove excess heat and humidity from the room. The walls are of brick, the floor of cement, and the arrangement such that the room may be easily kept clean.

* * *

STANDARD BABBITT SPECIFICATIONS

The Society of Automotive Engineers has published standards adopted by the society for various types of babbitt. These specifications are given below. The limits for the chemical compositions specified for metal in ingot form are closer than the limits specified for cast products, as allowances have been made for unavoidable variations in the chemical content due to casting. All compositions are given in percentages.

Specification for No. 13 Babbitt

	Cast Products	Ingots
Tin	4.50 to 5.50	4.75 to 5.25
Antimony	9.25 to 10.75	9.75 to 10.25
Lead, maximum	86.00	85.50
Copper, maximum	0.50	0.50
Arsenic, maximum	0.20	0.20
Zinc and aluminum	None	None

This is a cheap babbitt and serves successfully where the bearings are large and the service light. It should not be used as a substitute for a babbitt with a high tin content. It is also suitable for die-castings.

Specification for No. 14 Babbitt

	Cast Products	Ingots
Tin	9.25 to 10.75	9.75 to 10.25
Antimony	14.00 to 16.00	14.75 to 15.25
Lead, maximum	76.00	75.25
Copper	0.50	0.50
Arsenic, maximum	0.20	0.20
Zinc and aluminum	None	None

This is a cheap babbitt and serves successfully where the bearings are large and the service light. It should not be used as a substitute for a babbitt with a high tin content. It is also suitable for die-castings.

Specification for No. 10 Babbitt

	Cast Products	Ingots
Tin, minimum	90	90.75
Copper	4 to 5	4.25 to 4.75
Antimony	4 to 5	4.25 to 4.75
Lead, maximum	0.35	0.35
Iron, maximum	0.08	0.08
Arsenic, maximum	0.10	0.10
Bismuth, maximum	0.08	0.08
Zinc and aluminum	None	None

This babbitt is very fluid and may be used for bronze-backed bearings, particularly for thin linings, such as are used in aircraft engines. It is also suitable for die-castings. When finished bronze-backed bearings are purchased a maximum of 0.6 per cent lead is permissible in scraped samples, provided a lead-tin solder has been used in bonding the bronze and the babbitt.

Specification for No. 11 Babbitt

	Cast Products	Ingots
Tin, minimum	86.00	87.25
Copper	5.00 to 6.50	5.50 to 6.00
Antimony	6.00 to 7.50	6.50 to 7.00
Lead, maximum	0.35	0.35
Iron, maximum	0.08	0.08
Arsenic, maximum	0.10	0.10
Bismuth, maximum	0.08	0.08
Zinc and aluminum	None	None

This is a rather hard babbitt which may be used for lining connecting-rod and shaft bearings subjected to heavy pressures; its "wiping" tendency is very slight. It is also suitable for die-castings.

Specification for No. 12 Babbitt

	Cast Products	Ingots
Antimony	9.50 to 11.50	10.25 to 10.75
Copper	2.25 to 3.75	2.75 to 3.25
Lead, maximum	26.00	25.25
Tin, minimum	59.50	60.00
Iron, maximum	0.08	0.08
Bismuth, maximum	0.08	0.08
Zinc and aluminum	None	None

This is a relatively cheap babbitt and is intended for bearings subjected to moderate pressures. It is also suitable for die-castings.

* * *

BRITISH SPECIFICATIONS FOR STANDARD SHAFTING

The British Engineering Standards Association has brought out a set of specifications dealing with shafting for marine purposes—more particularly tail-shafts, propeller fits, keys, and flanged couplings. The range of shafts covered is from 6 to 20 inches in diameter. These specifications may be obtained for a price of 1s 2d from the British Engineering Standards Association, 28 Victoria St., S.W., 1, London, England. They should be of considerable value to American engineering firms engaged in shipbuilding and marine engine work, as they have behind them the best thought in the British shipbuilding field.

* * *

An enterprise is being promoted in England for bringing British manufacturers into closer touch with possible customers in Canada, the plan being to run a special train across Canada and back, calling at every city and town of importance on the journey. The train is to consist of cars fitted up as show-rooms for goods of all kinds and accompanied by qualified representatives. Stops will be made at the various cities and towns lasting from one to seven days. The train is to be preceded by a publicity agent, who will create interest in the business communities in advance of the arrival of the train.

Machine Tool Sales and Service Records

By GEORGE M. MEYNCKE, Sales Manager, The Oesterlein Machine Co., Cincinnati, Ohio

AN efficient sales department record system is of service to a machine tool maker in at least three ways: First, it emphasizes the necessity of keeping delivery dates promised on orders in process, and furnishes records of the destination of each machine built. Attachments, tools, or repair parts may be ordered in the future for any machine shipped, and it is then that the destination record becomes valuable. Machine tools have a longer life than most products, and requests for repair parts on machines built twenty or more years ago are not unusual. Machine tools have been developed greatly in the past fifteen years and changes in design and construction have been frequent, so that it is often difficult to meet such requests. There is a desire on the part of machine tool builders to be in a position to give better service in supplying repair parts in the years to come than has been the rule in the past, and the records that will make future service ideal must be built up from today.

SALES ORDER N° 1072 M

Lot 150 Type No.2 Plain C.S Range 28 X 10 X 17 Construction No. A 746
Agent The Swind Machinery Company Agent's Order No. 10322
Customer The Chester Auto Parts Company
Order Accepted, (Date) Jan. 8th, 1921 Shipped, (Date) Feb.14th, 1921
Class of work intended for
The following attachments must be shipped with order None

Remarks
Price Discount Net
SHIPPING INSTRUCTIONS
The Chester Auto Parts Company
Chester, Pa.
Via Penn. R. R.
Ok'd By Pack for Domestic—Foreign

Fig. 1. Information given on the "M" Order Slips for Machines

Second, the sales department record system is of assistance in planning production. Almost all types of machine tools are built in a series of sizes and styles by each builder specializing in one or more types. For instance, The Oesterlein Machine Co. builds sixteen plain and fourteen universal milling machines, and in addition, four other types of machines. Yet this is not exceptional. For these thirty-four machines the company makes a total of sixty-eight standard attachments, approximately 150 small parts such as arbors, collets, and face mills, and many other attachments which are built only on special order. In the normal operation of the plant, five months elapse from the time some material is put into operation until finished machines are available for delivery. This means that the planning of production must be based on estimates made as much as six months in advance of the shipping date.

The demand varies for different sizes and styles of machines and attachments; for example the company sells more No. 2 milling machines than any other size, and attachments for this machine rank the same. Because of this variation in demand, a study of sales records will give information of value in shaping production schedules. If records covering a three-year period indicate an average yearly sale of fifty attachments of a given size and type, one can safely plan on a yearly production of fifty of these attachments. When a six months' inventory is being figured on, the attachments should be produced in lots of twenty-five, because there are always irregularities in sales and often there is an unforecasted run on certain attachments. Without the help of a readily obtained "history of sales" the result will be either poor service or an unnecessarily high inventory. With this history, service will be improved and inventory charges will be in a desirable proportion.

Third, accurate sales records assist the sales managers. They enable the sales manager to work for an even distribution of the machines and tools manufactured by the company, and serve as a basis upon which to keep a check on the activity of the sales organization.

A Simple System Carries a Low Overhead

In starting to keep sales records, there is always the question as to what extent the overhead expense of record making is justified by the value of the records. The general tendency in office management is to inaugurate a routine that requires independent clerical work for each record. Such a system is frequently expensive, and its accuracy is dependent upon the thoroughness of those whose duty it is to fill out the records. Errors are likely to creep in when the records are made by different clerks at different times. The ideal system would be one in which all records would be made at one time. The system to be described closely approaches that ideal.

SALES ORDER N° 3303 R

Purchaser Badger-Packard Machinery Co. Quantity 1 No. 2 Swivel Vise
Purchaser's Order No. 29049
Agent's Territory
Machine Construction No.
Our Shop No.
Delivery Promised
Shipped (Date) 7/15/20
Remarks
SHIPPING INSTRUCTIONS
Menominee Motor Truck Co. of Wisc.
Menominee, Mich.
Ship Via Express
O. K'd By Price Discount Net

Fig. 2. The "R" Order Slip used for Attachments, Repair Parts, etc.

When an order is received, it is necessary to send some form of written instructions to the shop, either to build or to prepare for

shipment the machines that have been ordered. The only way to avoid this would be to give verbal instructions and that would rightly be considered poor management. With the system here described the instructions given to the shop are at the same time entered on all the record slips of the system.

All the orders that are received are divided into two classifications—"machines" and "replacements." Thus an order for a machine is entered on the "M" form illustrated in Fig. 1, while all other orders, whether for standard or special attachments, arbors, collets, or replacement parts are entered on the "R" order form shown in Fig. 2. Each of these order forms has three bond paper slips and one cardboard, between each of which a sheet of carbon paper is placed. These four blanks differ only in the heading, and so contain identical information when filled out. The top slip of the "M" order is headed "Sales Order"; the second, "Agent's Record"; the third, "Machine Record"; and the bottom card, "Customer's Record."

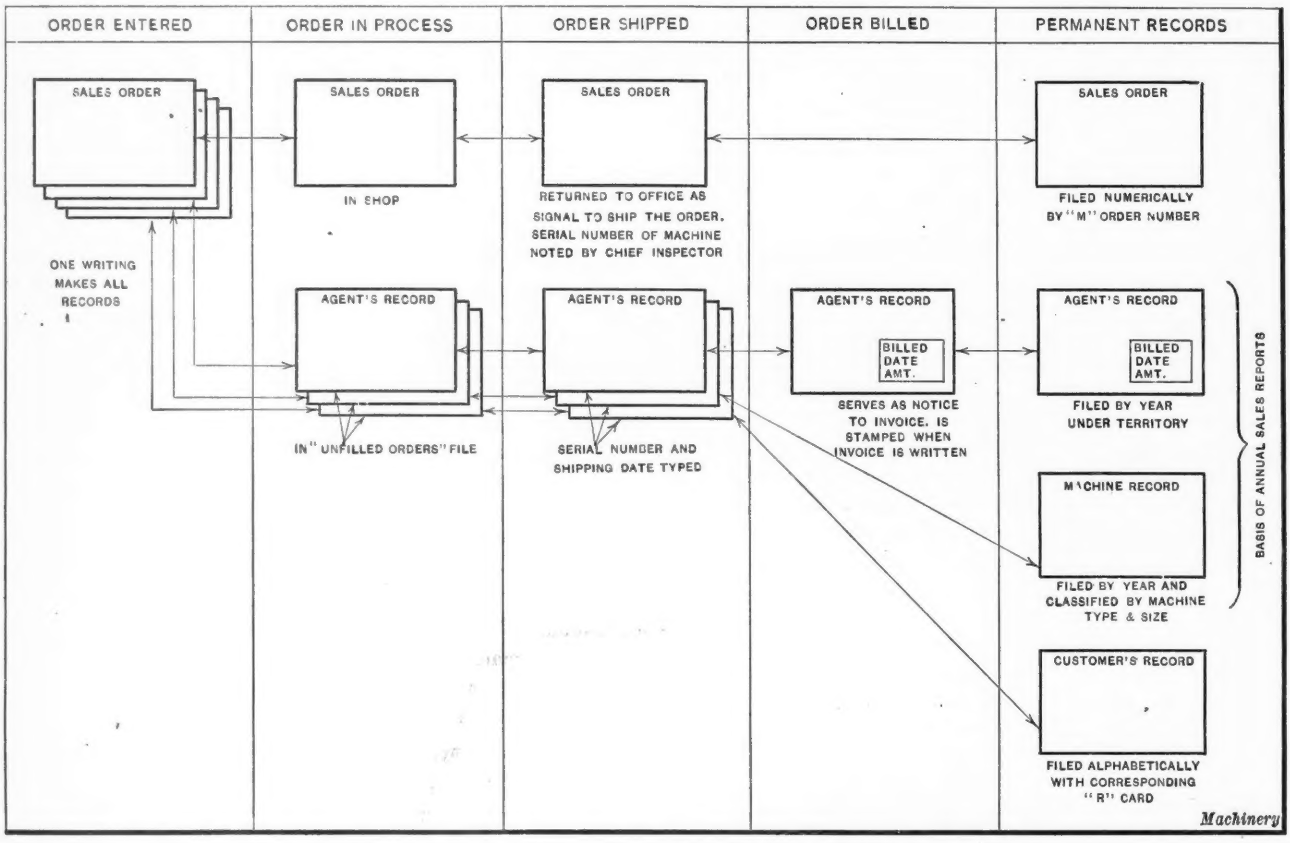


Fig. 3. Diagram showing the Routine of the "M" Order Slips to the Permanent Files

Functions of the "M" Order Slips

There are five steps in filling an order and establishing the permanent records, and as the steps are interdependent, no gaps can occur in the records, such as might happen if each step required a distinct clerical operation. The progress of an "M" order slip through these five steps is illustrated diagrammatically in Fig. 3. When a lot of machines is put into production, and this is ordinarily done some time before the machines are actually sold, the record slips for the lot are filled out as to size, lot number, and specified date of completion. These cards are filed according to the type and size of the machine, and deliveries are quoted from these "In Production" cards.

A pencil notation is made on the sales order slip when a delivery quotation is made to a prospective customer; thus a definite machine is actually quoted. If all the machines in process of a particular size have been quoted, no additional quotations are made until the company has been released from a quotation. If no releases occur, the delivery is quoted on the next lot of machines of that size to be put through the shop. This system has two advantages; first, it prevents the quoting of delivery dates for more machines than will be available on those dates, and second, it enables any member of the office organization to promise a correct delivery date.

When a formal order for a machine is received the order slips are filled out with the agent's name, customer's name, and order number, shipping instructions, and any other necessary notations. The sales order is then torn off and sent to the shop and the remaining group of three slips remains in the "unfilled orders" file, as indicated in the second column from the left in Fig. 3. When the machine is shipped, the shipping clerk marks the serial number of the machine on all four cards and turns over the agent's record slip and the bill of lading or express receipt to the auditor for billing. The fifth column shows the final disposition of the records.

When the order is completed, the sales order slip is filed numerically by the "M" order number as a permanent record of that particular order. The agent's record is stamped with the selling price of the machine and the date of billing, and is then filed in a yearly permanent file, classified according to the territory in which the plant of the customer is located. From this file the sales of a given territory, as represented by machines or by dollars, may be conveniently reviewed.

The machine record is filed yearly in a file classified by machine types and sizes, the purpose of which is to lighten the clerical work of the engineering department. As the serial number and lot number of the machine appear on all records, the number of every blueprint used in making the machine is quickly available by referring to the parts list for that lot. The machine record slips also furnish a ready reference as to the number of machines of a size or kind shipped during a given year. The customer's record is filed alphabetically with corresponding cards from "R" orders. By this arrangement a record of all the machines and tools that each customer has purchased is available.

An example of the service that the customer's record makes possible was demonstrated recently. A letter was received from a customer requesting that a 1¼-inch arbor

be sent to the writer. The order was indefinite in view of the fact that The Oesterlein Machine Co. manufactures nineteen 1¼-inch arbors of various styles and lengths, but upon reference to the customer's record file it was found that four years ago this company purchased a 1¼- by 17-inch style D, No. 11 taper arbor. So this order was duplicated without the delay of additional correspondence, and to the satisfaction of the customer. There was better than an even chance that the arbor sent would be the one desired.

Use of the "R" Order Slips

The information furnished on the "R" order slips is quite different from that given on the "M" slips. The "R" forms are not written up until orders are actually received, because standard attachments, arbors, etc., are carried in stock and are withdrawn to fill orders just as individual parts are drawn from stock by the assembly department. The first of the "R" slips is also called the sales order, and the last card the customer's record. The progress of this slip and card to the permanent files is the same as that followed by the corresponding slip and card of the "M" order. The second slip is called the sales order record, and is filed consecutively by the order number. The third slip is called the attachment record, and this slip is classified and filed under attachments, special fixtures, repair parts, etc. It affords a ready reference which is used in estimating the future demand for a particular part and really comprises a sales history of that part.

When attachments are to be included with a machine shipment, the slips of the "R" order covering the attachments and of the "M" order covering the machines, both bear a notation to that effect. The slips of parts sent out for repairs are filed by the piece number of the part. The engineering department studies these slips periodically, and, wherever possible, changes the part in design or material so that repairs will be eliminated. Information of value to the sales department may also be obtained from these records; for example, by checking over the records it was recently noted that no orders had ever been received for the replacement of milling machine shaft bearing. This sales point would probably have been overlooked if the number of repair parts for this particular piece had not been so "conspicuous by their absence."

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MACHINE FOR LAPPING ANGLE VALVES

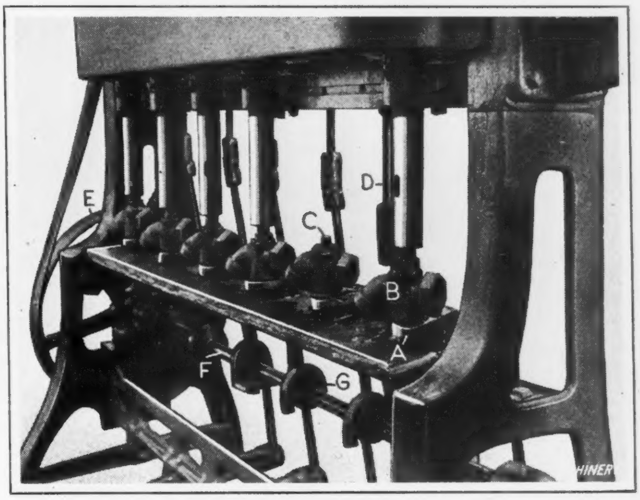
By ROBERT MAWSON

Various types of valves are required to be kept in service by railway repair shops, and as they are used for either steam or air lines it is necessary that they be perfectly tight. The valve parts are first machined on the two seating surfaces so that they will be as nearly interchangeable as possible after which these surfaces are ground or lapped together until a perfect contact is obtained. Many of the valves are lapped by hand, the workman simply oscillating the two parts while in contact after putting the necessary abrasive on the valve seat. When a large number of valves is to be lapped, this method is obviously too slow and costly.

The illustration shows a special machine made at one of the railway repair shops for lapping in the valve seats of an angle type valve. The tapered valve-stem and the valve body are first machined as nearly to the correct angle as possible. The valve body *B* is then placed on the machine, so that it rests on the plate *A*. It is prevented from turning by means of a pin in plate *A*. The valve-stem shown at *C* is placed in the body of the valve before the latter is mounted on the machine. Each lapping spindle is provided with a socket that fits the square end of a valve-stem. Each spindle can be raised by means of a foot-treadle, so that it can be dropped over the valve. Rods, such as the one shown at *D*, actuate the spindle-raising mechanism and are connected to the foot-treadles under the machine frame. The spindles are operated by gearing, the driven gears being attached to the upper ends of the spindles.

It is a well-known fact that parts can be lapped more accurately if the abrasive is moved along the surfaces during the lapping operation. If this is not done, the abrasive particles tend to cut grooves in the surface and spoil the finish, this being more noticeable if the faces are of considerable size, as in the case of the valves shown in the illustration. In the lapping machine shown the abrasive is moved along automatically at regular periods. A pulley *E* drives a horizontal shaft *F* located under the table. Fastened to this shaft are cams or eccentrics *G*, one for each valve lapping spindle, and over these cams are placed yokes, which are fastened by rods to the rear of the plates.

As the horizontal shaft is revolved, the cam or eccentric *G* is also revolved, and through the medium of the yoke and rod the plates *A* and the valve bodies are moved up and down. As the valve bodies are lifted, the valve-stem continues to revolve with the machine spindle. The raising and lowering of the valve body causes the abrasive particles to be moved along the surfaces being lapped, thus preventing grooves from being cut in the work. In operation, the machine is set up with six valves, but the operator can



Machine for lapping Valve Seats

examine any one of these at any time by raising the spindle by means of the foot-treadle. When the valve seat is found to be lapped to a satisfactory finish, another valve and valve-stem are substituted in its place, so that the operation of the machine is continuous.

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ALUMINUM-COPPER ALLOY CASTINGS

As far as can be estimated from available figures, according to R. J. Anderson in a publication "Preparation of Light Aluminum-Copper Casting Alloys," published by the United States Bureau of Mines, Washington, D. C., about 97 per cent of all aluminum-copper alloys are made from an alloy containing approximately 92 per cent aluminum and 8 per cent copper. Among the other alloys used for commercial castings are those containing from 2 to 13.5 per cent copper, the remainder being aluminum. In 1920, 81,000,000 pounds of aluminum-copper alloys were made in the United States.

Alloys containing from 4 to 6 per cent copper are reported to have been used in Italy for aircraft-motor castings, and the 96–4 aluminum-copper alloy is used extensively in the United States for sand-cast cooking utensils. In the United States a favorite motor-piston alloy is made with from 9 to 10.5 per cent copper, the remainder being aluminum, but some plants introduce iron as well as copper to increase the hardness. In the United States, the consensus of opinion among foundrymen is that the alloy containing 92–8 aluminum is the best alloy available for general casting purposes.

Press Feeding and Grinding Attachments

TWO patented feeding and grinding attachments, applied to a No. 3 Bliss power press, are used in the manufacture of drop-wires for cotton looms, in the plant of the Hopedale Mfg. Co., Milford, Mass. These drop-wires are punched out from ribbon stock, and vary in thickness from 0.004 to 0.030 inch, and in length from about 4 to 7 inches. Both of these attachments are automatic in operation and have been the means of greatly increasing the output over that obtained with any other equipment.

Fig. 1 shows the feeding device, which is attached to the left-hand side of the press, and driven by sprockets and chains from the crankshaft. A sprocket wheel on the lower sprocket shaft, and chain *A*, drive the feed-rolls through which the stock is fed to the dies. The upper sprocket wheel is integral with a spur gear of the intermittent type, and thus drives the pinion shaft *B* which is geared to the lower driving roll as shown. The feed is varied to suit the different lengths of drop-wires by changing the feed gears, but the intermittent gearing is not changed for this purpose.

The feed-rolls and the gears that drive them are integral, and can readily be replaced by others when desired. The lower roll is supported by two trunnions, each resting in a half bearing box. These bearings are spring-supported and adjustable to compensate for the difference in center distance caused by changing the gearing. The screws *C* are provided for making this adjustment. The feed-roll gears are thrown into mesh by the cam-lever *D*, which, by reason of its cam end, raises or lowers the split bearings in which the lower feed-roll is supported. When in the raised position, this lever constitutes a lock to hold the rolls in engagement while the stock is being fed through them. As the stock is passed through the rolls, it is guided by a curved guard *E* which reaches over between the rolls, thus preventing anything but the stock from passing between them.

Obviously, the stock must be delivered at the same level as the top of the dies; hence when the dies wear or when it becomes necessary to change the feed-rolls, the line of feed must be correspondingly changed. For this reason, vertical adjustment for the entire bracket which carries this mechanism is provided for; this adjustment is effected by screw *F*, shown below the bracket, and a locking nut. As the stock leaves the rolls it is fed through a flat chute, the passage in which is just large enough to permit the stock to move freely through it. The top side of this chute is the stripper plate for the punch, the opening in the top of the chute being just sufficient to enable the punch to enter. There is an adjustable sheet-metal guard *G* attached to the side of the machine, which encloses this feed-chute, to obviate the possibility of tangled stock being fed under the punch in case it should not be delivered properly into the feed-rolls. A riveted sheet-iron drawer *H* is hung under the bolster plate of the machine, into which the scrap is deposited. This box can be quickly and conveniently removed when the scrap is to be dumped.

The grinding attachment, which is fastened to the right-hand side of the machine, is illustrated in Fig. 2. This view also shows the nature of the work. The operation consists of removing the burrs produced by the dies in punching out the work. The grinding attachment is belt-driven from a countershaft on the floor. The driving-pulley shaft of the attachment carries a worm *A*, which drives a short vertical shaft *B* through a worm-wheel at its lower end. Worm-shaft *C* is driven from this vertical shaft by helical gearing, and carries a worm *D* which drives the worm-wheel *E*. This worm-wheel acts like a crank, reciprocating the shifter bar *F*, the right-hand end of which is connected to a driving post in the worm-wheel. Spur gear *G*, also carried on this worm-shaft, drives the grinding wheel, which is located beneath plate *H*, by a suitable gear train.

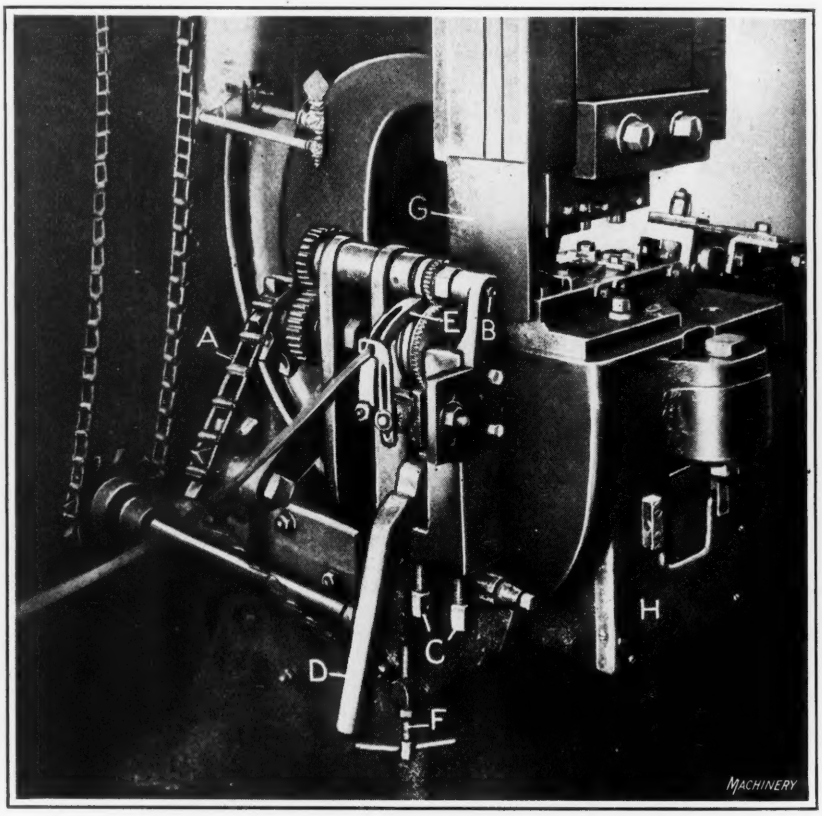

Fig. 1. Intermittent Automatic Feed Mechanism for Power Press

The reciprocating movement imparted to shifter bar *F* causes the delivery chute *I* to swing back and forth and distribute the work over the wide face of the grinding wheel. Obviously, this provision is made to equalize the wear on the face of the wheel. The end of the shifter bar carries shifter arm *J*, the end of which is coiled around an annular V-groove in the special sliding pulley *K*. This pulley is flanged and drives a woven-fabric belt *L*, the opposite end of which passes over a pulley attached to the bolster plate of the machine. The chute is constructed in sections so that it may be adjusted to agree with the length of work being handled. The lower end of the chute simply rests on the sliding pulley.

The feed-rolls, of which there are two pairs, front and rear, and the grinding wheel, are supported in an angular plane on the special bracket *M*, which is attached to the base of the machine and supports the other elements of the mechanism. The grinding wheel is 5 inches in diameter and 3½ inches wide, and is provided with tapered bronze bearings *N* which may be adjusted to take up wear by the collar-screw shown. The casting in which these

bearings are located contains two posts O, one at each side of the wheel, and the roll-supports P are cut out to ride vertically on these posts when the position of the rolls is being adjusted relative to the top of the grinding wheel, over which the work is passed. The lower roll of each pair is supported by a spring-backed bearing R, which provides the required variation in tension to suit the different thicknesses of stock.

The entire delivery unit, including the rolls and their supports, is adjusted relative to the end of the chute by the adjusting screw and nut carried in arms at the top of each side post O. The work passes between a curved plate and the grinding wheel, the space between these two being adjusted periodically to compensate for wheel wear and to suit different thicknesses of stock. This adjustment is accomplished by tightening or loosening the nut S, thus varying the tension on the curved plate exerted by a coil spring carried in the tube T.

The drive of this grinding mechanism is independent of the operation of the machine, the shipper-rod handle being shown at U. The dies used in this operation are of ordinary construction, and require no special description. The stroke of the press is 2 inches. The machine is provided with a counting device. The unusual production of 230 drop-wires per minute is attained with this equipment, which is two and one half times greater than had previously been obtained.

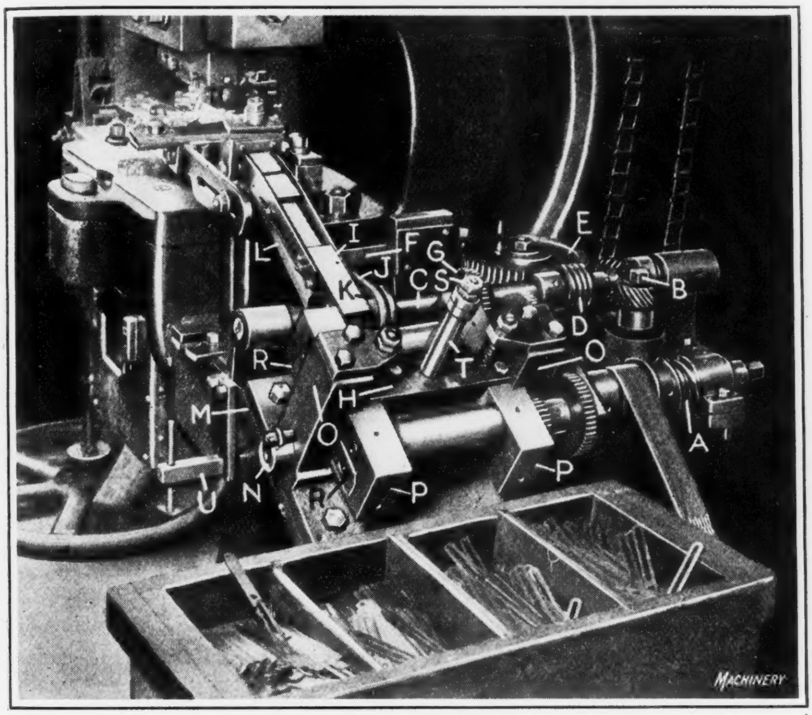

Fig. 2. Grinding Attachment for Power Press

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AUTOMOBILE NUMBERING DEVICE

A drilling device to be used in a new method of "branding" automobiles and trucks, something after the manner in which ranch animals are branded in the West has been developed by a New York engineer, Jack Marshall, of 509 Fifth Ave., New York City. The Marshall automobile-numbering device is a drilling machine which automatically drills any given number, letter, or symbol, or any manufacturer's or license number into the body, motor, or any other part of the car, thereby making it impossible for automobile thieves and dealers in stolen cars to change the numbers. The numbering machine is operated by electricity, and the number is large enough so that it can easily be seen.

KEEPING TOOL-CRIB RECORDS

By A. F. PSYKE

Considerable trouble was experienced in a certain plant in keeping a record of the tools checked out or withdrawn from the tool-crib. This trouble was caused mainly by operators who were absent for several days or who left the plant altogether without returning the tools to the crib. In many cases the tools could not be located without a great deal of delay. When it became evident that this condition was seriously affecting production, the routine outlined in the following, was put into effect.

The foreman of each department was instructed to have his supervisors check all machines and benches a half hour after starting time each morning, and in the event of an operator being absent, reassign his job and tools to another operator, giving the latter a ticket that indicated the change. The operator assigned to the job would then take this ticket and his own checks to the tool-keeper who would change the tools and place the absent operator's check on his hook.

In case the absent operator's job had been completed and he had not turned in his tools, or the job had not been completed and could not be taken over by some other operator, the supervisor simply turned in the tools at once to the tool-keeper who placed the checks on the hook allotted to the absent operator, where they remained until he returned, or a notice that he had left the plant was given out.

If an operator was absent for three consecutive days without notifying the foreman as to the cause of his absence, he was considered to have left, and the foreman, in making out a "leaving notice," ascertained from the tool-keeper whether the operator was charged with any tools, and if so, he made mention of this fact on the "leaving notice," so that when the operator went to the factory office for his termination slip, the employment clerk could notify the tool-keeper who would see that the operator returned all tools charged to him. The tool-keeper would then sign the operator's "leaving notice," and send it to the employment department, where the man was paid off. The final payment of wages was never made until all tools were accounted for.

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INEXPENSIVE DIE FOR ORNAMENTAL EMBOSSING

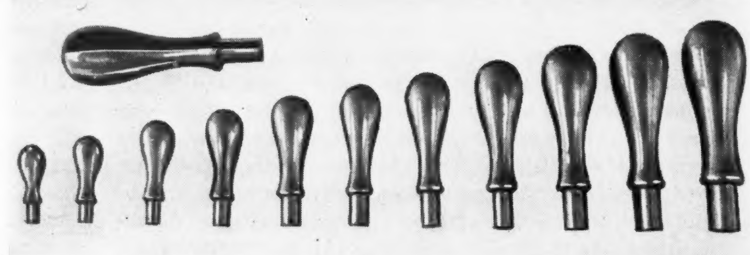
By ELAM WHITNEY

Ornamental embossing such as is found on many tin toys is generally done on punch presses. Embossing dies for this work are expensive to make, due to the care required in matching the engraved face of the punch with that of the die. It has been found practical in some cases to engrave the punch only, and make the die of a hard babbitt, the punch then being pressed into the babbitt to form the die impression. The surplus babbitt raised at the edge of the impression made by the punch is scraped away to leave a smooth matching surface. A die made in this way can be renewed after a few days use by melting the babbitt and making a new impression. Of course, this method of making a die can be used only for light work in tin, brass, or other soft metal of light gage. For such work, however, it will give good results and often make it possible to manufacture small quantities of embossed parts at a profit when the cost of regular engraved dies would be prohibitive.

Pressed-steel Machine Handles

A Process for Manufacturing Hollow Seamless Machine Handles

By FRED R. DANIELS



AN innovation in the manufacture of machine handles has recently been made. The new method consists of drawing the handles from steel blanks. By this means a handle is produced which is light, uniform in shape, and of adequate strength. This process of manufacturing hollow pressed-steel handles has been developed and patented by the Rockwood Sprinkler Co. of Worcester, Mass. A complete line of these handles, comprising eleven sizes, is shown in the heading illustration. The proportions of the handles are given in the accompanying table. The specifications given have been adopted as Rockwood standards, but they are the same as those used by manufacturers of solid handles machined from bar stock. There are two types of these handles; one has a shank integral with the handle, and the other has a loose spindle around which the handle can rotate freely.

In the solid handle of the loose-spindle type, machined from bar stock, these spindles or pins are riveted over at the end and finished to conform with the contour of the handle. With this construction, the headed-over pin may project sufficiently to permit dirt to work in and prevent the handle from turning freely. The projecting pin is also likely to injure the operator's hand. In the pressed-steel handle of this type, the spindle or pin does not project, but is contained in a bearing within the drawn shell, as shown in the upper right-hand corner of Fig. 1, and so cannot become loose.

Sequence of Operations

The evolution of a handle, step by step, is shown by the diagrams in Fig. 1. The dimensions given are for a No. 7 handle (see table); those for other sizes are, of course, in proportion. All sizes are made from strip steel, varying in thickness from 0.062 to 0.100 inch, and sixteen operations are required (including annealings) to finish a handle. The first operation is blanking and drawing on a double-action press, which is followed by annealing. Then there are two redrawing operations, followed by annealing, bringing the shell to shape 4.

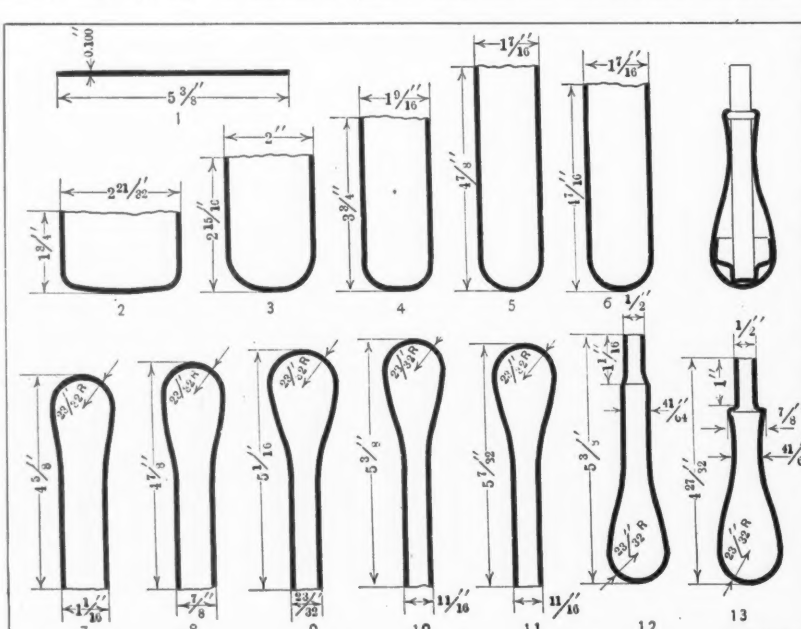


Fig. 1. Sequence of Operations in making a No. 7 Pressed-steel Machine Handle

In the course of manufacture, the stock becomes thickened from the small diameter of the handle to the shank. If special means were not provided to anticipate this thickening, the stock would become so thick that in the final upsetting operations it would be likely to buckle, so that it would be practically impossible to maintain the shape; also, particularly on the smaller sizes, the hole in the shank would be practically filled. Consequently the next redrawing operation is performed with a punch designed to thin the shell at the upper end. This is shown graphically at the left in Fig. 3. The shell is next squared on the end and annealed. If the handle is of the loose-spindle type, the next operation is slipping in a pressed-steel bearing, as shown at the right of shape 6, Fig. 1.

Reverse Drawing or Necking

The necking operations which follow are the same for both types of handles; in the case of the loose-spindle or quick-action handle, these operations result in closing the large end of the handle so that the bearing is prevented from coming out. There are four necking operations produced by what is known as "reverse drawing." Between the first two and the last two necking operations the shells are annealed. The dies employed in the reverse drawing operations are of substantially the same design in all cases, with suitable modifications, of course, to accommodate the various lengths and diameters of shells.

Fig. 2 shows a press set up for the first necking operation, while Fig. 3 shows, in section, the type of punch and die used in all the reverse drawing operations. The dotted lines show the relative positions of the punch and the shell before necking, and the full lines the positions at the completion of the operation. The shell is placed in the die closed end up, and centered between two spring slides. As the punch descends these slides are forced radially outward to permit the punch to make a complete stroke and force the shell into the die. The press is equipped with a device for ejecting the shell after it has been necked. It will be noted that the

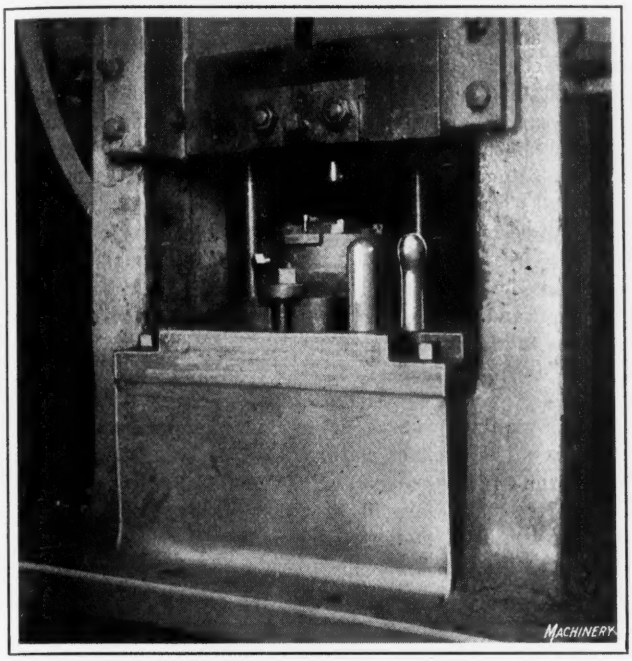


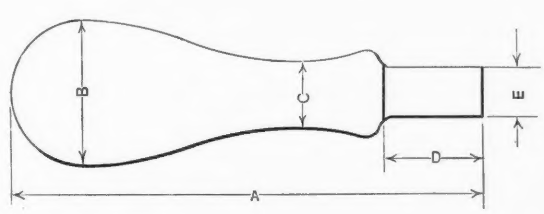
Fig. 2. Power Press Set-up for First Reverse Drawing Operation

punch is a plain cupped-out tool which serves merely to force the shell straight downward. Shape 11, Fig. 1, shows the shell after it has been squared on the end following the necking operations.

Forming the Shank

The next step in the sequence of operations on the type of handle with the integral shank, is drawing the shank

DIMENSIONS OF ROCKWOOD PRESSED-STEEL HANDLES



Size	A	B	C	D	E
00	2	⅝	11/32	29/64	¼
0	2 13/64	¾	⅜	½	5/16
½	2 19/32	13/16	13/32	9/16	5/16
1	2 15/16	15/16	15/32	⅝	⅜
2	3 5/16	1	½	11/16	7/16
3	3 17/32	1 3/32	33/64	¾	7/16
4	3 13/16	1 3/16	35/64	13/16	7/16
5	4 3/16	1¼	37/64	27/32	7/16
6	4 17/32	1⅜	39/64	15/16	½
7	4 27/32	1 7/16	41/64	1	½
8	5⅛	1 9/16	¾	1 1/16	⅝

Machinery

end to the finished diameter, which for a No. 7 handle is ½ inch. In this operation, the shell is reversed from the position occupied during the necking operations, and a punch is used which fits over the 41/64-inch diameter and compresses the end to the proper size. This results in elongating the shank end slightly, just enough so that in the final upsetting operation the correct length of shank from the shoulder to the end will be obtained.

The dies used in the final upsetting operation are illustrated in Fig. 4; in this illustration a handle is shown in the die preparatory to upsetting. A safety guard which assures that the handle will be located vertically is used. This guard consists of two sheet-metal members which, when they are together, form a hole large enough for the handle to enter and seat in the die. The handle cannot be placed incorrectly in the die as long as this guard is closed.

On the descent of the ram, a V-shaped cam *A* strikes the rounded end of the two slides to which the guard members are attached, and spreads them against spring tension. This occurs at the same time that the two side cams *B* (see also Fig. 5) come into operation and close the slides that secure the handle in a vertical position. It will be seen from Fig. 5, which is a sectional view of this die at the completion of the

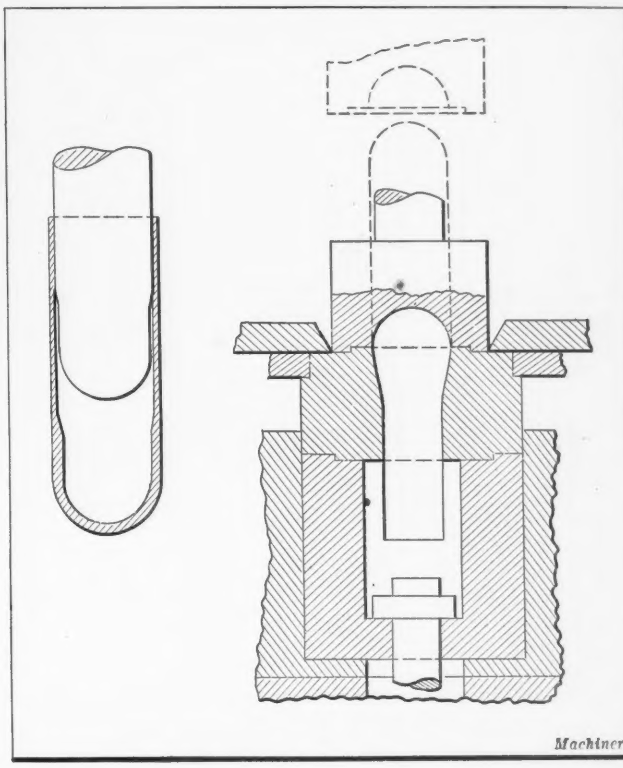


Fig. 3. Diagram illustrating how the Shell is thinned, and Cross-section of Dies used in Necking or Reverse Drawing

operation, that the faces of these slides are formed to give the correct curvature to the handle, and that the upsetting operation not only forms the shoulder but also spreads the handle to give it a reverse curve at the top near where the shank begins. The shape of the punch is clearly indicated.

As soon as the operation is finished and the ram ascends, the die parts immediately spring back into their original

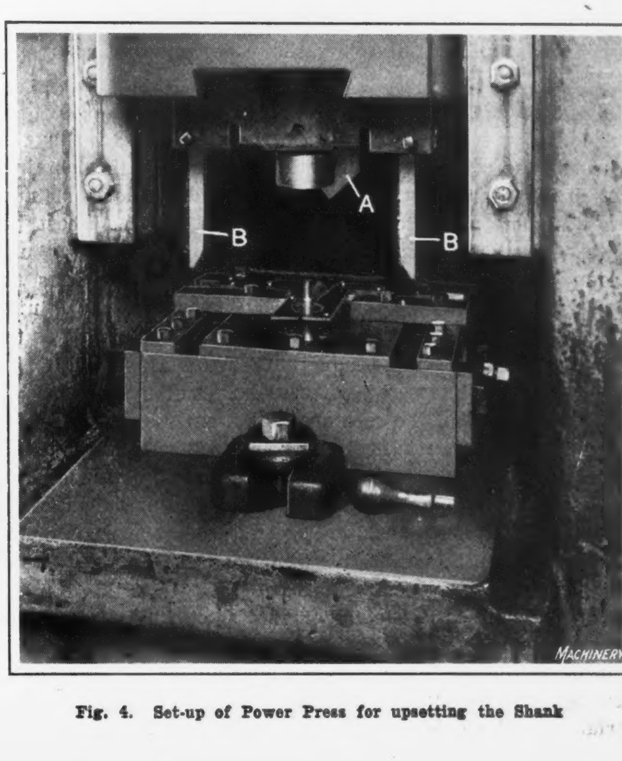


Fig. 4. Set-up of Power Press for upsetting the Shank

position, opening the slides and permitting the completed handle to be removed. In the case of the quick-action handles, the blank size is so calculated that after necking, it is only necessary to force the cold-rolled steel spindle into the shell and close the ends around the flange machined on it.

The weight of pressed-steel handles made by the Rockwood process is about one-half that of solid machine handles made from bar stock. The actual weight of a No. 7 solid

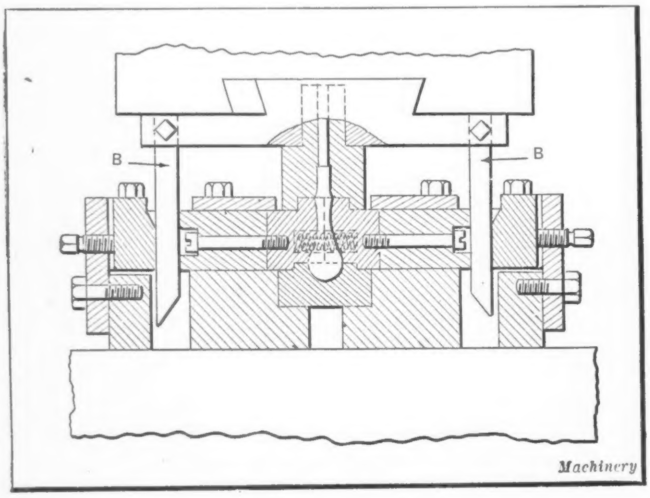


Fig. 5. Cross-sectional View of Dies used in the Final Upsetting

steel handle is 15 ounces, while that of a pressed-steel handle of the same size is 7 ounces. The cost of hollow pressed-steel handles is the same as that of the solid type.

* * *

EFFICIENCY OF GRINDING WHEELS

Grinding wheels cannot be compared accurately without keeping records of their action. Methods of judging the efficiency of grinding wheels are described in an article published in *Grits and Grinds*, of which the following is an abstract. The records kept for determining the efficiency of a grinding wheel should indicate how a wheel compares with others, considering all conditions affecting its use. Wheels for different kinds of grinding operations cannot be judged in the same way, as characteristics desirable in a wheel for cylindrical grinding may render a wheel absolutely unfit for snagging. The following three classes of grinding will be considered: Off-hand grinding, or snagging; precision grinding; and miscellaneous grinding.

Wheels for Off-hand Grinding

The most important factor with regard to a snagging wheel is the cost of removing the metal, the finish obtained not being important. The total grinding cost includes wheel, labor, and overhead costs. The overhead cost per unit of time is constant, whereas the overhead per unit ground varies and depends on the production. Thus the higher production, the lower the overhead charge per unit. The total grinding cost per hour is not so important as the actual cost per unit of production. To obtain the latter, it is essential to know the wheel, labor, and overhead costs, the wheel life, and the rate of production.

The life of a grinding wheel is, in itself, unimportant because no idea of the production can be obtained from this information, and the true cost per unit cannot be calculated. If two wheels are compared on the basis of life alone, the result is that the wheel with the longer life is regarded as the better for the work.

Production rate is the important factor in deciding upon the efficiency of a grinding wheel, and this can be ascertained by determining either the number of pounds of material ground off, the number of castings ground, or the tonnage of castings ground. The first method can be applied to any type of casting, as both large and small castings can be compared on this basis, since the actual material removed is considered. The second and third methods are not as satisfactory on account of the variation in the size or kind of castings, but if castings of the same type and size are being ground, these methods also prove satisfactory. When the size varies greatly, the third method is better than the second, although either one gives only an approximation. From the rate of production per hour, the wheel life, and the operator's wages, the overhead charges, and the wheel and labor costs per unit ground can be calculated, and the total grinding cost per unit determined.

Precision Grinding Operations

The roughing wheels used in cylindrical and surface grinding of a precision nature must be of a structure that will permit rapid removal of the stock, because the finish is not important. As in the case of snagging, either the cost per pound of metal ground off, or the cost per unit of production is the basis upon which the efficiency of the wheel should be determined, and in such a calculation the factors involved in the case of snagging wheels must also be dealt with here. An additional item of importance, however, is the cost of the diamond used for truing the wheel. There are some jobs for which the unit diamond cost is larger than the cost of the grinding wheel. When grinding standard parts, the diamond cost can be obtained easily over a period of time and the cost per unit calculated.

When wheels are used throughout their life on the same kind of work, such as roughing crankshafts and camshafts, pistons, etc., the number of pieces ground is usually a satisfactory production figure. This is because each has practically the same amount of stock to be removed, so that the number of pieces ground is nearly a measure of the total amount of material removed. If the wheels are used for a variety of work, it is impossible to obtain a correct production figure except by going to a great deal of trouble. The cost per unit ground cannot be obtained without keeping detailed records, which would have to be so comprehensive that the expense would probably not be justified, and so these wheels must be compared on a different basis.

Assuming that the wheels are cutting satisfactorily, there are two factors that should be considered—wheel life and the amount of dressing necessary. The best wheel would be the one with the longest life and fewest dressings, bearing in mind the assumption that the wheels are considered equally desirable from the cutting standpoint. The finish obtained with a finishing wheel determines the use of that particular wheel for this class of work. After the desired finish is obtained, the wheel that will produce this finish at the lowest cost per unit should be found and used.

Miscellaneous Grinding Operations

The classification of miscellaneous grinding includes tool and cutter grinding, general off-hand grinding, and any other operation where production is not important. For work of this type, it is impossible to get comparative figures, the operator's opinion of the wheel action being in nearly all cases the deciding factor. In tool, cutter, and drill grinding, finish is important, for the cutting edge must be keen and there must be no burning. The actual amount of stock removed per wheel is not of fundamental importance, although naturally, if the finish and rate of cutting are the same, the wheel having the longest life should be chosen.

The wheels for off-hand grinding jobs are chosen, not because they last longer, but because they fulfill certain special requirements. A wheel may be used for squaring the ends of rods. Such a wheel must hold its shape, so that constant dressing is unnecessary, and in most cases a little burning would not be objectionable. On the other hand, for sharpening lathe and planer tools, the wheel must cut cool and the finish must be good.

Drawing Sockets for Wrenches

AMONG the many products of the plant of the New England Pressed Steel Co., at Natick, Mass., are sockets for wrench sets and for spark-plug wrenches. This work is essentially plain drawing work. The standard sizes for the wrench-set sockets for hexagonal nuts range from 5/16 inch to 1 9/32 inches across flats, and for square heads from 13/32 inch to 1 9/32 inches square. All sockets are 1¾ inches long. The operations performed in manufacturing the hexagon type of socket will be described in this article.

In the upper part of Fig. 1 is shown a collection of these wrench sockets ranging from ⅜ inch to 1 9/32 inches across flats. Directly beneath these there is a set of samples showing the work after successive operations on one size of socket. A double-end spark-plug wrench, 29/32 inch by 1 1/32 inches across flats, is shown at *H*, and a 31/32-inch single-end spark-plug wrench at *K*. Both of these spark-plug wrenches are 4 inches long, the double wrench being punched at each end for the insertion of a handle or rod, while the single wrench is drawn with a square hole at the neck end to accommodate a ½-inch square extension by means of which the socket is turned when gripped by the wrench. The long spark-plug wrench *I* is a 13/16- by 1 1/32-inch double-socket wrench with separate sockets assembled on a square bar, giving an over-all length of 8 inches. This wrench is made for a large automobile manufacturer, and was designed to replace a more costly wrench previously made from tubing. The remaining example *J* is a 1 5/32-inch single spark-plug wrench with extension, which was also made for a large automobile manufacturer.

Fig. 1. Socket and Spark-plug Wrenches, and Complete Set of Shells for One Size of Socket

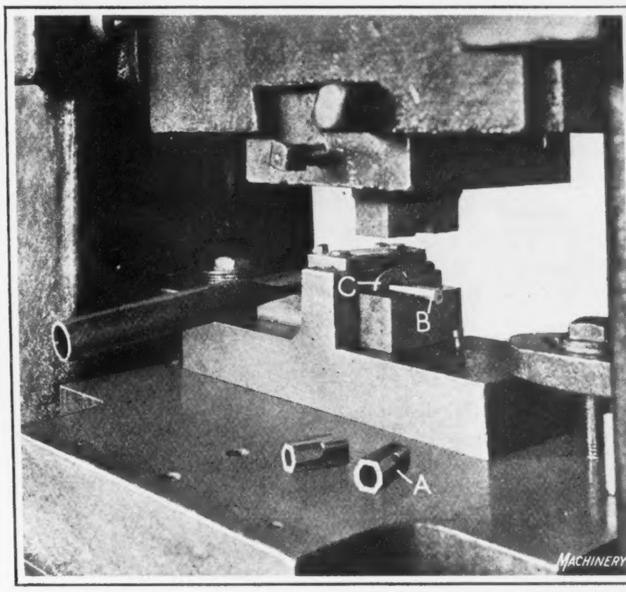


Fig. 2. Restriking the Wrench Sockets after the Hexagonal Hole has been drawn

In making the sockets for wrench sets, blanks of one diameter are regularly utilized for drawing up a number of similar sizes. The operations performed in making the ⅞-inch socket are representative, and this size only will be considered in describing the process of manufacture. The socket is made from 0.109-inch hot-rolled annealed stock, using a blank 2 11/16 inches in diameter. In the first operation, the work is blanked and drawn to the shape shown at *A*, Fig. 1; this produces a shell ¾ inch deep, having an inside diameter of 1 9/16 inches. The shell is next redrawn to 1⅛ inches inside diameter, 1⅛ inches deep, and then annealed and oil-treated before any further reduction in diameter can be satisfactorily performed. After annealing, the shell is necked to a length of ¾ inch and to an inside neck diameter of 0.940 inch, as shown at *C*.

In the second necking operation, the same neck length is maintained, but the diameter is reduced to 0.740 inch, which results in slightly elongating the shell to the shape shown at *D*. The punch used in the following operation squares the neck as at *E*. The inside size of the hole in the neck is then 0.518 inch square, which will accommodate a ½-inch square extension, and the outside size is 0.685 inch. The final press operation is drawing the cylindrical end of the socket to a hexagonal shape, ⅞ inch across sides, inside, and 1 1/32 inches outside. This results in lengthening the socket to about 2 inches over-all, so that the ends may be faced to bring them parallel and to the specified over-all length of 1¾ inches. The work at this stage of the manufacture is shown at *F*. All of these press operations, with the exception of the first, may be performed on any press having a 6-inch stroke or over. To complete the socket, it is simply necessary to punch out the closed end and square both ends to the proper over-all length, as shown at *G*.

Procedure in Drawing Various Sizes of Sockets

The regular practice in making sockets for hexagonal nuts less than ½ inch across flats, is to draw the square end of the socket, and then neck the closed end preparatory to forming the hexagonal shape. In the case of sockets for hexagonal nuts greater than ⅝ inch across flats, the reverse order is followed, as described in the foregoing. This practice is necessary, of course, on account of the comparative sizes of the two ends.

However, in making sockets for ½-, 17/32-, 9/16-, and 5/8-inch hexagonal nuts, the difference in size between the two ends of the socket is so little that the inside corners of the square end extend beyond the sides of the hexagonal part and the corners of the hexagonal hole extend beyond the sides of the square end, so that it is impossible to draw the hexagonal end completely with a square-pilot punch, or the square end with a hexagonal-shaped punch. Obviously, the punch must maintain alignment for the two differently

shaped ends. Consequently, the punch used on these few sizes is shaped square on the pilot end and the section which otherwise would be hexagonal is made to a special shape, which draws a shell such as indicated at *A*, Fig. 2. This permits a square-ended punch to be used to draw the closed end, but makes it necessary to restrike the special-shaped opposite end to form the required hexagonal shape. The amount of stock in both the hexagonal and square ends of sockets of the sizes mentioned is so nearly equal that the hexagonal end can be formed subsequently in this way without difficulty.

Fig. 2 shows the dies used in restriking the hexagonal end of a 17/32-inch socket. The die is provided with an auxiliary arbor *B*, which is withdrawn from the work after restriking, by means of the hand-lever. Arbor *B* works through a loose washer *C* which acts as a stripper when the arbor is withdrawn from the socket. A rack containing a quantity of punches and dies such as are used in making sockets is shown in Fig. 3.

Fig. 3. Rack containing Punches and Dies used in drawing Sockets for Wrench Sets and for Spark-plug Wrenches

Making Spark-plug Wrenches

The sequence of operations followed in making a spark-plug wrench is as follows: The double-end wrench, 29/32 inch by 1 1/32 inches in size, shown at *H*, Fig. 1, may be taken as an example of the work. This is made from 0.095-inch hot-rolled steel, the blank being 4½ inches in diameter. The work is first drawn in a toggle press; this operation produces a shell having an inside diameter of 2⅝ inches and a depth of 1⅛ inches. The shell is next oiled and annealed and subjected to two redrawing operations, in both of which a single-action press is used. The inside dimensions of the shell produced after each operation are 1⅞ inches diameter, 2 inches deep, and 1½ inches diameter, 2⅝ inches deep. The shell is then again annealed to relieve drawing strains and the surface oiled. In a third redrawing operation, the shell is further reduced to 1 5/16 inches inside diameter, 3⅛ inches deep.

A single-action press equipped with a knock-out operating from below is next employed to draw the small end. The length of the neck thus produced is 1⅞ inches and the inside dimension between sides 1.076 inches. Next, this cylindrical end is formed to a hexagonal shape in the same press as was used for the necking operation. This produces the required inside dimension between sides, that is, 29/32 inch, and draws the neck to 2⅛ inches. The opposite end of the wrench socket is next formed to a hexagonal shape, which produces the final inside dimension across flats for the opposite end, that is, 1 1/32 inches, and leaves the socket 4¼ inches over-all.

The socket is next held in a vertical position on a drilling machine table, and the open end squared by means of a fly cutter. This leaves the 1 1/32-inch end 2 inches long, as desired. The closed end of the socket is then punched out, after which the finished over-all length is obtained by squaring the small end on a drilling machine with a fly cutter. There are two holes diametrically opposite each other in the ends of the socket, and these are punched out on a short-stroke press, arbors of the correct size being used to hold the work. The sizes are then stamped on each end, and the wrenches inspected.

* * *

RESULTS OF INVESTIGATION AND RESEARCH

An interesting example of what can be accomplished by research and carefully conducted tests is brought out by the experience of the American Malleable Castings Association. This association was formed about twenty years ago, and has been consistently working since then on improvements in the quality of malleable castings. The ultimate strength of this product twenty years ago averaged 39,000 pounds per square inch, and the elongation was 3.5 per cent. At that time there was no systematic mechanical testing of the products of malleable iron foundries. The metallurgy of the foundries was not well understood, and the character of the product depended largely upon hit or miss methods. Through systematic research, carefully made tests, and thorough investigations, it has been made possible in the past four years to bring up the average ultimate strength to 53,000 pounds per square inch, and the elongation to 15 per cent. Many members can make a product considerably higher in ultimate strength and elongation, but the figures quoted are the averages of all the member foundries.

* * *

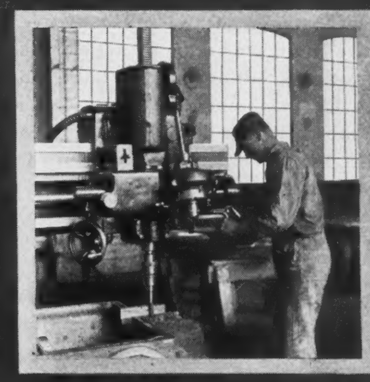
SYSTEM FOR NUMBERING STEELS

A system of designating kinds or qualities of steels by code numbers, each of which would represent a definite specification, will be developed as a result of the decision of a conference of the principal producers and users of steel recently held at Washington, D. C., at the call of the American Engineering Standards Committee. The conference recommended that this code be developed under the procedure of the committee, and suggested that the Society of Automotive Engineers and the American Society for Testing Materials be appointed joint sponsors.

* * *

During the eleven years preceding 1921, over $2,500,000,000 was spent on the building of highways in the United States, exclusive of the amount spent for maintenance. The investment in automobiles and motor trucks in the United States during the same period is estimated at nearly $9,000,000,000.

Letters on Practical Subjects

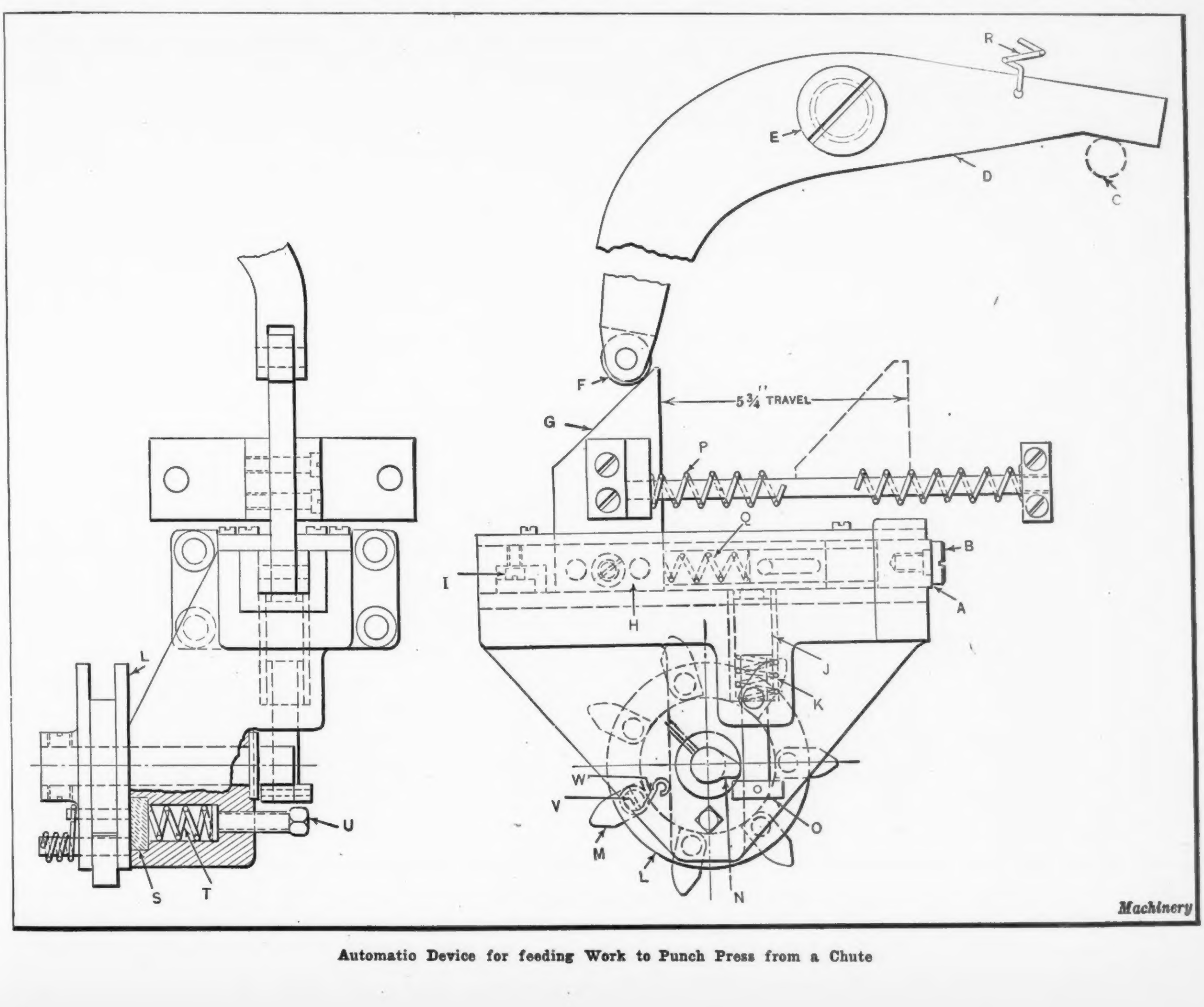


AUTOMATIC FEEDING DEVICE FOR PUNCH PRESS

The device shown in the accompanying illustration was developed for a special purpose, but the principle involved is adapted to a variety of punch press work. The problem was to feed a nut into a die designed to punch out slots or castellations in the nut head. The press used for this operation makes six strokes in producing the castellations on a hexagonal nut, one side only being punched at each stroke. The feeding movement takes place automatically on every seventh stroke of the press. One stroke is required to eject the completed nut and to feed another nut into the die, thus leaving six working or cutting strokes. After the nut is carried to the die, the device holds it there under pressure during the punching operations.

The nuts are placed in a hopper so that they drop down in front of ram *A* of the feeding device, where they come in contact with the head of the locating screw *B* which is screwed into the end of the feeding ram. On the upward stroke of the ram the pin *C* pushes the outer end of rocker *D* upward. The rocker pivots on pin *E*, thus throwing the end that carries roller *F* forward, which, in turn, pushes block *G* to the right toward the die. Block *G* is pinned to part *H*, which is connected through a spring arrangement with plunger *A*. When plunger *A* reaches the end of its feeding stroke, stop-block *I* is directly over pin *J*. Pin *J* will then be forced up by spring *K*, thus locking part *H* in its forward position. The feeding movement as described is completed at the end of the upward stroke of the press ram.

It will be seen that ratchet wheel *L* has seven evenly spaced teeth like that shown at *M*. Attached to the punch press ram is a steel bar (not shown) which on every downward stroke strikes one of the ratchet teeth, so that the ratchet wheel *L* is turned or revolved one tooth space. Thus, on every seventh downward stroke the ratchet wheel completes one revolution. Attached to the ratchet wheel is a



Automatic Device for feeding Work to Punch Press from a Chute

cam *N*, which makes contact with the collar *O* on every seventh stroke of the press ram. The collar *O* is pinned to the plunger *J*, and so at every seventh downward stroke the holding plunger *J* is pulled down so that springs *P* force blocks *G* and *H* back into the position in which they are shown in the illustration. This action releases the nut which has been held by the end of plunger *A* against the die under the pressure exerted by spring *Q*. Another nut then slides down in front of plunger *A*, and as the press ram returns to the upward position, this nut is carried to the die, and the slotting operation is repeated.

Spring *Q* has a double duty to perform. This spring holds the nuts, which vary in length, tight in the die during the slotting operation, and at the same time serves as a safety device in case a nut should not be ejected and two nuts should become jammed against the die. Lever *D* is held up and out of the way of pin *C* by spring *R* so that it will operate only on the feeding stroke. A fiber shoe *S* actuated by spring *T*, the pressure of which can be adjusted by screw *U*, holds the ratchet in whatever position it occupies after each indexing movement.

The teeth *M* are pivoted on pins *V* and are normally held in the positions shown in the illustration by springs *W*. This construction allows one of the ratchet teeth to be depressed by the ratchet-operating bar as it rises on the up stroke of the press ram. At the end of the up stroke the tooth that has been depressed snaps back into place so that the bar will catch it on the return stroke and thus revolve the ratchet wheel one tooth space.

Atlanta, N. Y. JOHN E. COLLINS

DRILL JIG WITH TILTING BASE

A drill jig that can be tilted or revolved to any desired position is shown in Figs. 1 and 2. This jig is employed at the plant of an engine manufacturer for drilling the base and cylinder casting of a 1½-horsepower engine. The jig is shown in a vertical position in Fig. 1 and in a tilted position in Fig. 2. The joint faces of the work at *A* and *B*, Fig. 2, are milled and the cylinder bore *C* ground previous to the drilling operations. These finished surfaces are employed in locating the work in the jig, the cylinder bore being placed on a locating plug. There is nothing unusual in the method of locating and clamping the work in place, the point of interest being the universal adjustable feature which permits the jig to be brought into any position.

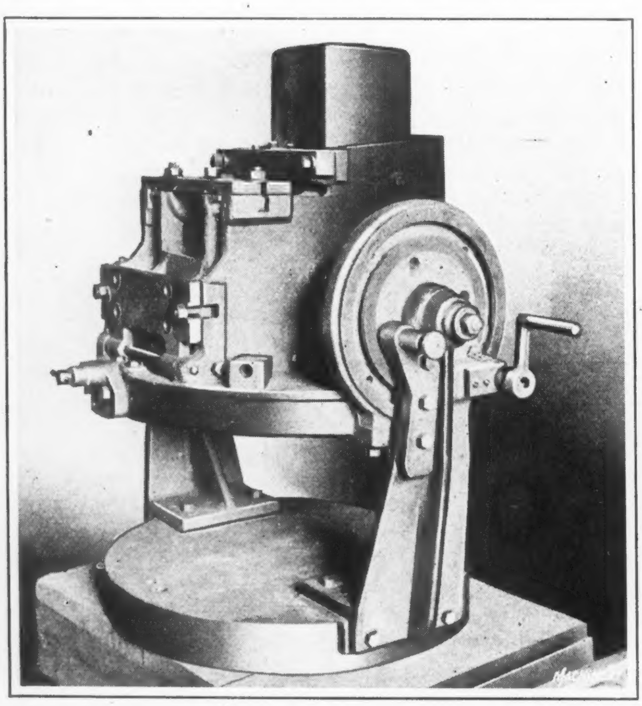


Fig. 1. Drill Jig with Tilting Base

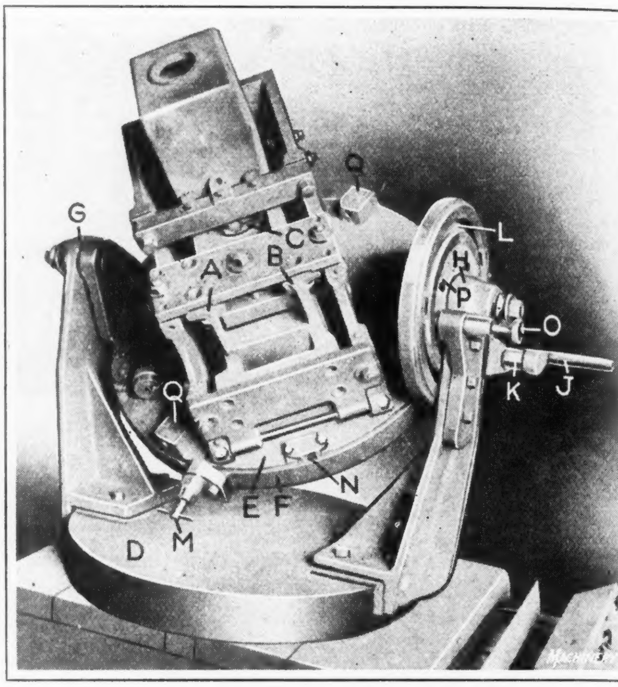


Fig. 2. Drill Jig in Tilted Position

The base casting *D* was designed to fit the table of a vertical drilling machine. The circular base *E* of the fixture can be revolved on the sub-base *F*. The sub-base *F*, in turn, is mounted on trunnion bearings *G* and *H*, and can be tilted to any desired position. No end motion is permitted in the bearings *G* and *H*. The shaft *K* of crank *J* is screwed into a circular T-shaped wedge which fits in the circular groove *L* so that sub-base *F* can be clamped in place by turning crank *J*. The workman can rotate the jig on the trunnion pins of bearings *G* and *H* and also revolve base *E* on the sub-base *F*. The proper location for certain drilling operations is insured by the index-pin *M*, which fits into pockets, such as the one shown at *N*. There are four of these pockets but only two can be seen in the illustration.

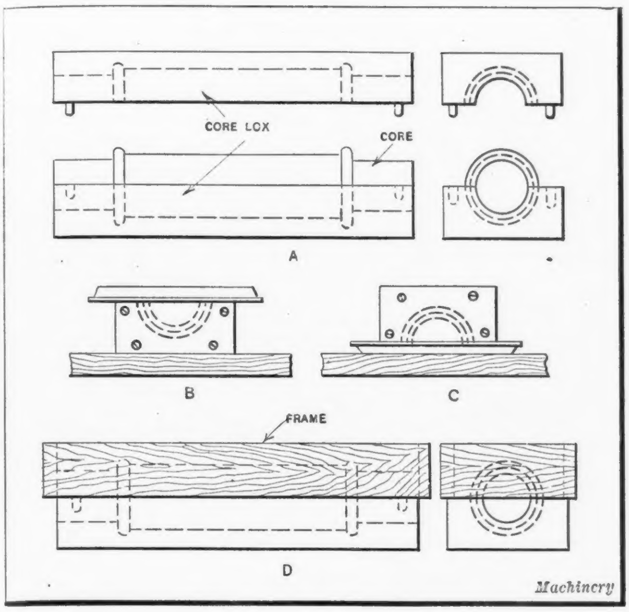
The base *E* is machined to a good turning fit in the sub-base *F* so that the jig and casting will be rigid when located in any position. The index-pin *O* can be inserted in any one of four holes in plate *P* so that the jig can be accurately set in four different positions with respect to its vertical axis. The two bosses *Q* are drilled to allow a bar to be inserted for use in revolving base *F*. In the operation for which this jig is used, twenty-four holes ranging from ¼ to ⅝ inch in diameter are drilled and tapped without removing the work from the jig.

Providence, R. I. ROBERT MAWSON

WHY A FULL CORE-BOX?

Nearly every patternmaker has at one time or another made a full core-box with the parting line through the middle as shown at *A* in the accompanying illustration. If many of the core-boxes made in this way were examined when returned from the foundry, it would be noted that only the upper or lower half was made use of. The molder usually finds it much easier and simpler to use only one-half of the core-box, but the patternmaker is often unaware of this and continues to make full core-boxes when only a half core-box is necessary or desired by the molder.

The method of using the half core-box will be evident from an inspection of views *B* and *C*. After attaching wooden blocks or pieces to the end of the half core-box, the latter is laid on the coremaker's bench. The core sand is filled in and rodded (if necessary), and the surplus sand struck off. A core-plate is then laid on the top of the half core-box and the latter rolled over into the position shown at *C*. The half core-box is next lifted off and the core is



(A) Full Core-box; (B) Half Core-box with Core-plate on Top; (C) Half Core-box in Position to be drawn from Core preparatory to baking; (D) Frame required to support Core when Full Core-box is used

ready for the oven. The venting is done after the cores are baked. Two half cores made as described are pasted together to form the complete core. The ends of a half core-box should always be closed, as shown in views *B* and *C*, in order to retain the core sand.

One of the advantages gained in using the half core-box is that the half core can be laid on an iron core-plate for the baking operation, while a round core such as made in the box shown at *A* must have a black sand bed to support it during the baking operation. It is therefore necessary to provide a frame such as shown at *D* for the black sand bed when the full core-box is used.

Kenosha, Wis. M. E. Duggan

PREVENTION OF POWER PRESS ACCIDENTS

It is not uncommon for the foreman of a power press department to hear an injured operator offer the excuse that "the trip mechanism repeated." A foreman who has had charge of a large department of power presses for more than twelve years informed the writer that he never had known one of his presses to repeat. He stated that the greater number of accidents occurred on foot-operated presses, and this fact seemed to indicate that nearly all accidents were due to carelessness alone.

Great care should be taken in the design and construction of guards. It is to be regretted that power presses are sometimes provided with guards that prove more harmful than beneficial. Dial feeds and progressive dies should be used whenever possible, and even though the first cost is greater, the increased production obtained and the greater safety provided will more than compensate for the additional expense.

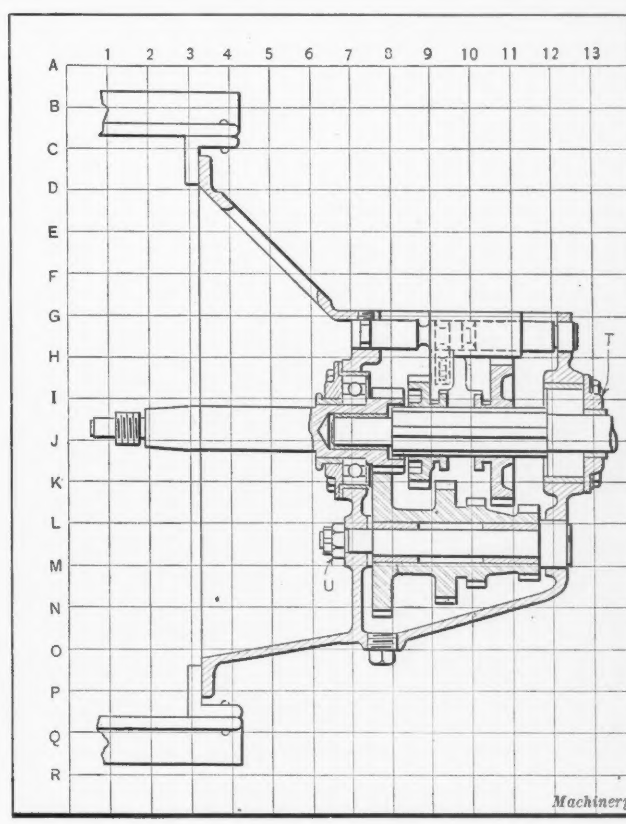
The piece-work system should never be applied to dangerous press jobs, and rules regarding the use of "pick-ups" or workholders for placing the work on the die should be strictly enforced. This refers to such operations as forming, shaving, bending, etc. Power presses should be enclosed by a fence or partition, whenever possible, in order to prevent the operators from engaging in any chance conversation with those whose duties require them to pass through the department. When new work is being tried out, the press should be slowed down as much as possible until the operator has become accustomed to handling the pieces. The writer has always been of the opinion that the only reliable safety device for a power press is one that requires the operator to use both hands, and that is so designed that the knee cannot be used to operate either of the handles.

S. N. Bacon

LOCATING AND DESIGNATING PARTS ON ASSEMBLY DRAWINGS

Assembly drawings are sometimes made confusing by the large number of arrow-heads or leaders used in connection with letters or numerals to designate different parts. This commonly employed method, however, can be easily avoided, as shown in the accompanying illustration. The assembly drawing in this case is made in the usual way, but no leaders or arrows are used to point out different parts. Instead, very light vertical and horizontal parallel lines are drawn, which divide the drawing into square sections as shown. These lines should be drawn with ink of some color (light red or yellow) that forms a contrast with the black lines of the drawing itself, and they should be so light that they will not spoil the general appearance of the drawing.

It will be noted that the vertical parallel lines are numbered while the horizontal lines are lettered, A, B, C, etc. In this way it is necessary to give only the number and letter of the vertical and horizontal lines, respectively, that intersect at some point on any part to enable anyone to find that part quickly. This plan is similar to that used on many maps, except that it is sometimes necessary to place the lines closer together so that a point can be located definitely within a fraction of an inch. The notation "flange I–13" will enable one immediately to locate the part *T*. The letter *T*, however, will not appear on the drawing. The spaces between the vertical and horizontal lines may, in some cases, be required to be divided into tenths or even finer subdivisions of an inch. Assuming that this has been done in the case of the drawing shown in the illustration, nut *U* might be referred to as "L.5–6.5." N. G. Near



Assembly Drawing with Vertical and Horizontal Lines for locating or designating Parts

SLOTTING AND INDENTING DIE

The die shown in Fig. 1 was designed for use in the production of cases for electrical instruments. It is used for punching the slot *A* and producing the two indentations at *B* and *C*, Fig. 2. The lugs or projections formed on the inside of the case by the indenting operation, in conjunction with the slot, serve to support the dial of the instruments. The cups for the case are blanked and drawn in the usual way, and two holes *D* are punched in the bottom to receive two wire terminal screws.

The design of the slotting and indenting punch is clearly shown in Fig. 1, while the details of the die member are shown in Fig. 3. The die *F* is so shaped as to provide a clearance on all sides of the work except at the points where the hole *A* is punched and the indentations *B* and *C* are made. Die *F* is counterbored to receive the pivoting pin-plate *G* which is provided with two pins *H* and *I*, as indicated by the view in the lower right-hand corner of the illustration. When the work is placed on the die, the pins *H* and *I* pass through the pierced holes *D*, Fig. 2, and hold the work in place during the punching and indenting operation. Pin *I* passes through the pin-plate and extends into a slot in the die *F*, where it is normally held in the correct operating position by the coil spring *J*.

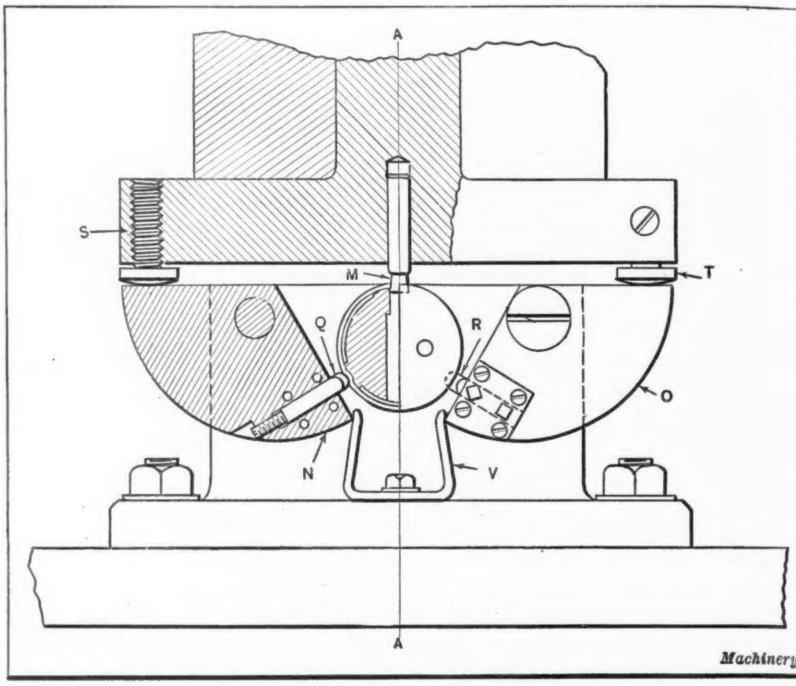


Fig. 1. Slotting and Indenting Die for Electrical Instrument Case

The work is removed from the die after the forming and indenting operation has been performed, by giving the cup a slight twist so that it is rotated sufficiently to bring the lug impressions at *B* and *C* out of their die slots. The slot punchings at *A* fall down through a vertical hole into the inclined hole *K* and thus out at the rear of the bolster plate. The bottom of the vertical hole is closed by a beveled plug *L*. The two indentations or lugs at *B* and *C* are produced by punches located in swinging segments *N* and *O*, Fig. 1, which are pivoted on substantial supports on either side of the work.

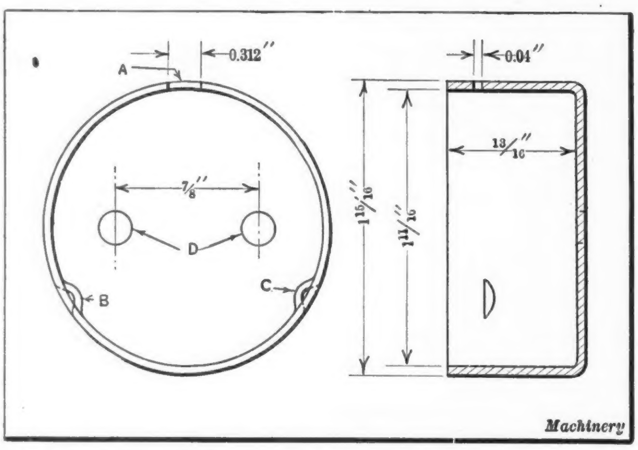


Fig. 2. Case on which Slotting and Indenting Operation is performed

The swinging segments *N* and *O* of the die are slotted to receive the indenting punches *Q* and *R*, which are made from ordinary tool bits. These punches are firmly clamped in their respective slots by means of two set-screws which pass through plates that are securely fastened to segments *N* and *O*, as shown in the illustration. Adjustment of the indenting punches is obtained by screws *S* and *T*. A flat single leaf spring *V* of U-shape is used to separate the swinging segments on the up stroke of the press. When placing the blank cups on die *F*, Fig. 3, no motion is imparted to the indexing plate, and only a slight twisting motion is required to permit the work to be withdrawn after the completion of the punching and indenting operation.

Allentown, Pa. JOE V. ROMIG

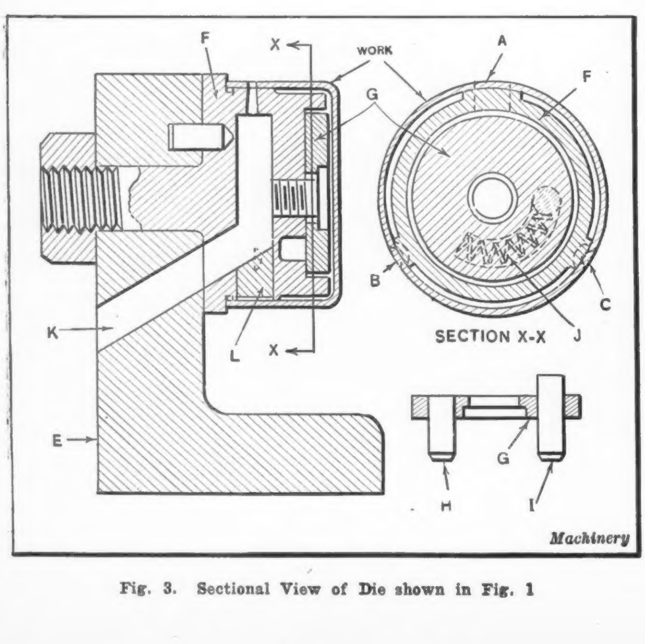


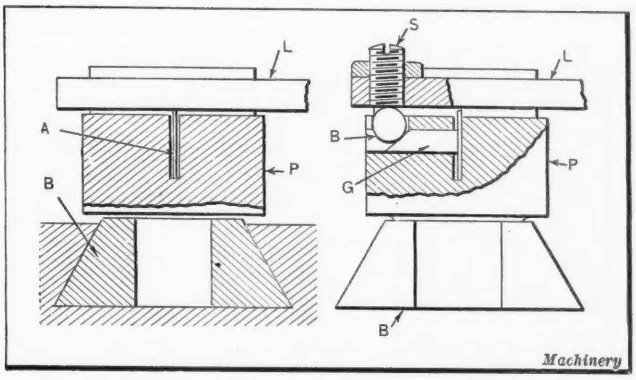
Fig. 3. Sectional View of Die shown in Fig. 1

FEEDING DEVICE FOR WIRE-FORMING MACHINE

Feeding mechanisms of various designs are employed on automatic wire-forming machines. The design shown in the view at the left in the accompanying illustration is often used for flat or ribbon stock. The ribbon stock *A* is run on edge throuh a slot in the post *P* which reciprocates with the feed-slide *B*. The feed-slide is actuated by a lever *L* having a roller that travels against the face of a feed-cam. A second motion is imparted to lever *L* by a "rise-and-dwell" cam on the hub part of the feed-cam. The latter cam has a dwell which continues for about one half revolution. The action of this cam causes the feed-slide end of lever *L* to press downward on the stock so that the latter is gripped between the lever and the bottom of the slot in post *P* during the forward movement.

With this type of feeding device there is necessarily a sliding of the gripping surface on the stock before a firm grip is obtained. There is also excessive friction and wear on the working parts. A realization of the disadvantages

of this feeding device in one plant where a number of machines were employed on ribbon stock led to the development of a new device. The improved device is shown in the view at the right-hand side of the illustration. Most of the parts in the original device were used in the improved design. The post P was drilled for a plunger G, which is forced to grip the stock on the feeding stroke by the downward movement of the ball B which is in contact with the beveled end of the plunger as shown. When the end of lever L is depressed by a cam during the feeding stroke, it causes ball B to maintain pressure on plunger G. This pressure on the plunger is sufficient to keep the stock from slipping in the slot in post P. The screw S provides a convenient means for obtaining close adjustment for stock of different thicknesses. The principal advantage of the improved feeding device is the lighter tension required to obtain a positive grip on the stock (which is clamped on its flat surfaces instead of on its edge), a feature which eliminates bending or marring of the stock. The parts of the device which are subjected to wear are hardened. The plunger and ball fit loosely in their pockets so that the stock is instantly released when the lever L drops from the cam dwell at the end of the feeding stroke.



Plain and Improved Types of Feeding Devices for Wire-forming Machine

Middletown, N. Y. DONALD A. HAMPSON

DETERMINING HEIGHT OF ANGULAR FACED BLOCK

A block with its top surface at an angle to its sides, and one of its sides of a predetermined height, is sometimes required to be accurately machined and measured. The top surface of two blocks of this type is represented in Figs. 1 and 2 by the lines VW. In both illustrations H represents the height or dimension that is required to be exact. In this article a convenient method of checking height H is described. Referring to Fig. 1, it will be noted that the short side of the block is the one to be checked, while in Fig. 2 the longer side is to be checked.

By placing a square against the side of the block, or preferably by clamping a parallel against the side of the block so that the edge of the parallel can be shimmed up and clamped in a true vertical plane, a known angle UVW can be formed. A button is placed in the corner thus formed, and a height gage employed to determine the height from the top of the button to the surface plate on which the piece rests. The exact height of the side of the work can then be determined by the formulas given in the following. If the corner of the piece has been rounded off, the height of the projected corner will be found.

First considering the case illustrated in Fig. 1, we have

R = radius of button used;

a = angle that top of piece makes with surface plate;

C = height from base of surface plate to upper side of button as determined by means of a height gage.

The height H of the side of the block can now be found as follows: First we have,

$$b = \frac{90 \text{ degrees} - a}{2} \quad \text{and} \quad P = R \cot b$$

Now

$$C = H + P + R$$

By substituting

$$C = H + R \cot b + R$$

and

$$H = C - R \cot b - R = C - R (\cot b + 1)$$

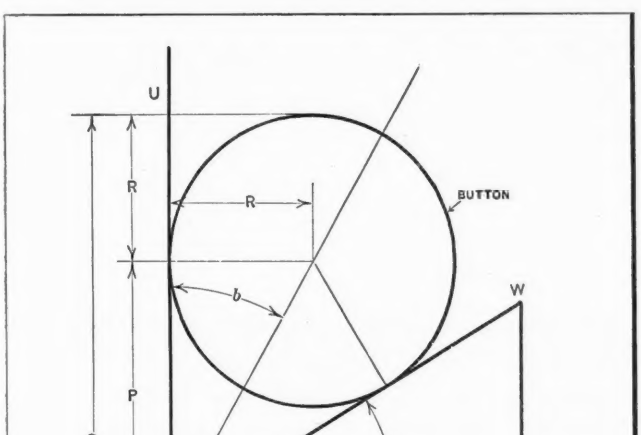


Fig. 1. Diagram used in finding Height of Angular Faced Block

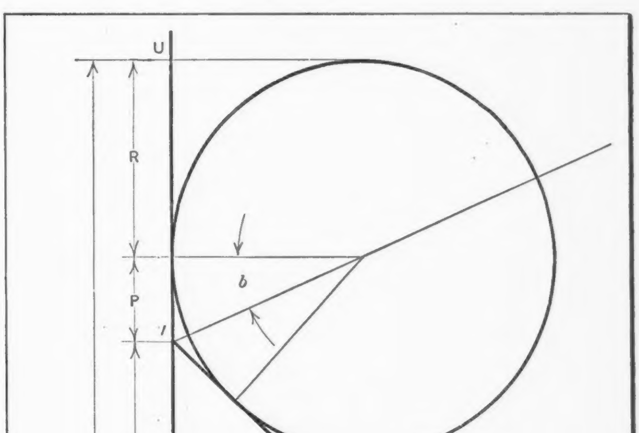


Fig. 2. Diagram showing Method of determining Height H

Now considering the case illustrated in Fig. 2, we have,

$$b = 90 \text{ degrees} - \frac{180 \text{ degrees} - (90 \text{ degrees} - a)}{2}$$

$$= \frac{90 \text{ degrees} - a}{2}$$

Now

$$P = R \tan b \text{ and } C = R + P + H = R + R \tan b + H$$

Then

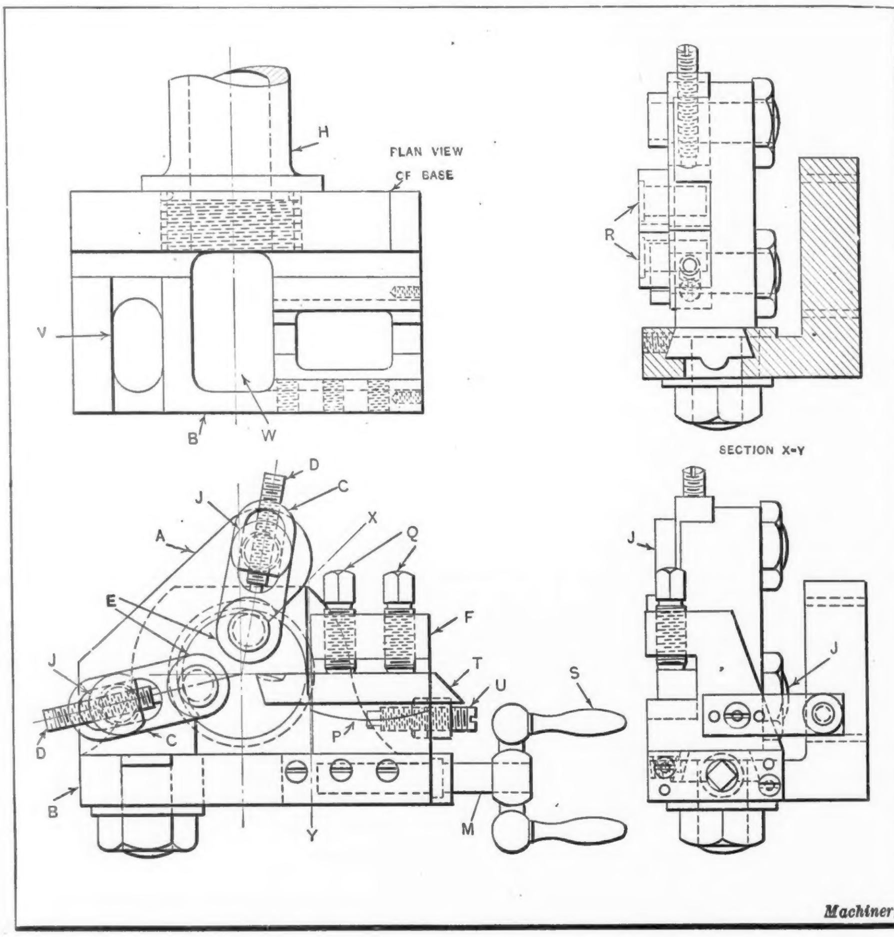
$$H = C - R \tan b - R = C - R (\tan b + 1)$$

Flint, Mich. W. G. Holmes

BOX TURNING TOOL EQUIPPED WITH A CROSS-SLIDE

The tool here illustrated was designed to eliminate some of the difficulties experienced in using box-tools for screw machine work. In this tool, hardened and ground rolls mounted in hardened and ground bushings are substituted for the usual V-rest. Set-screws are provided for making fine adjustments of both the tool and the work-supporting rolls. The base B is tapped to take the shank H, which is made to fit the ordinary type of hand or automatic screw machine. The shank is made hollow to permit the work to pass through it when turning operations on long pieces are performed. The bracket A is grooved so that roller brackets C may slide in it. Adjustment of the rollers E is obtained by means of screws D.

The clamping screws J are provided for holding the rolls in position. The pins R are made a tight fit in brackets C. The toolpost F slides in a dovetailed slot in the base, and is adjusted by means of screw M. The handle S is made a loose fit on the screw, so that it can be removed when not in use. The toolpost and adjusting screw are assembled and operated in much the same manner as the cross-slide of an engine lathe. A rocker P is provided on the toolpost, which allows the point of the tool to be set above or below the center, depending upon the work being turned.



Box Turning Tool which is equipped with a Cross-slide

The clamping screws Q are provided for holding the cutting tool T. A positive stop on the side of the toolpost allows the tool to be returned to its original cutting position after being withdrawn. The positive stop shoulder on the base is arranged to make contact with an adjusting screw U. The feed-screw M allows the tool to be adjusted after it is clamped in position in the holder. This feature saves time in setting up the machine, since it eliminates the necessity for hammering the cutting tool into position, which is the method frequently employed in setting a box-tool.

The screw that holds the body bracket A passes through an elongated slot V in the base, thus permitting the rolls to be set either ahead or in back of the cutting tool. The usual chip opening W is provided in the base beneath the cutting tool. The assembled tool takes up about the same amount of space as the usual type of box turning tool, so that no additional clearance is required when it is employed. The tool shown has a capacity ranging from 5/32 to 1 inch.

Turtle Creek, Pa. J. H. Davis and Joseph Demmer

ALIGNING A PUNCH WITH A DIE

In making dies, a method known as "staking" is sometimes employed to change the position of the punch slightly in the punch-holder so that it will be in accurate alignment with the die. The "staking" operation is often accomplished by making prick-punch marks in the punch-holder close to one side of the punch. The compressing of the metal in this manner forces the punch over a little. When the shape of a die is changed slightly by the hardening process, the punches can often be "staked" over so that they will be brought into alignment again. It is difficult to align punches properly by this method when they are spaced close together. It has been found, however, that punches that have been aligned by "staking" often give trouble, so this method must be regarded as a makeshift and should not be commended except in unusual cases.

A better method of obtaining accurate alignment of the punches is to harden and grind the dies before making the punch-holder. In this case, the finished die is fastened to the unbored punch-holder by means of accurately fitted temporary dowel-pins. The punch-holder with the die attached to it is then clamped to the faceplate of the lathe. After the hole in the die has been aligned with the spindle of the lathe by the use of an indicator, the die is removed and the hole bored in the punch-holder. The same procedure is followed until the holes for all the punches have been bored.

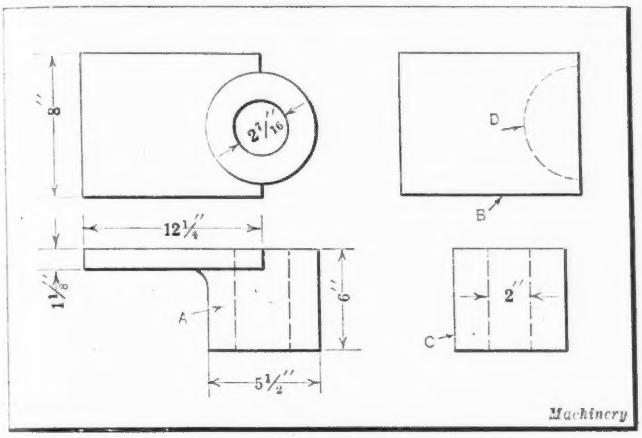
For irregular shaped punches, it is customary to shave the punch into the die. With this method the die is hardened and ground, and the punch machined to within 0.010 inch of the finished size. The soft punch is then forced into the die to a depth of about 1/64 inch by means of a screw press, after which the punch is filed to within a few thousandths of an inch of the outline produced by the die. This shaving and filing process is repeated until the proper fit has been obtained.

Elam Whitney

Shop and Drafting-room Kinks

REPLACING A BROKEN BEARING

Quick thinking and resourcefulness on the part of the foreman machinist in a certain shop were evidenced recently in the promptness with which a broken bearing was replaced and the machine put back in operation. The improvised bearing, as evolved by the foreman, is shown at *A* in the accompanying illustration. While the outside dimensions of the repair bearing are different from those of the cast-iron bearing that it replaced, it served its purpose equally



Repair Bearing and the Pieces from which it was made

well and made it possible to resume production with little delay.

To make the repair bearing, the foreman used a piece of machine steel *B*, 1 1/8 inches thick by 8 inches wide by 12 1/4 inches long, and a cast-steel gear blank *C*, which had been bored and turned ready for cutting the teeth. These pieces were taken to the welding department where a section was cut out from the piece *B* (as indicated by the dotted lines *D*) with a cutting torch. The pieces *B* and *C* were then assembled on a flat plate and welded together to form a bearing, as shown by the view at *A*. After the welding operation, the hole in the hub was bored out to a diameter of 2 7/16 inches. After clamping holes had been drilled, the bearing was ready to be assembled in the machine.

Kenosha, Wis. M. E. Duggan

BENDING TUBING

One of the oldest methods of preventing metal tubing from assuming an oval or flattened shape while it is being bent is to fill the tube completely with rosin or lead. The rosin or lead can be readily melted and allowed to run out after the bend has been completed. A second method, not so well known, is to fill the tube with a snugly fitting coil spring. After the tube is bent, the spring can be readily removed in the following manner:

One end of the spring is fastened to a lathe spindle so that it can be rotated in a direction which will cause it to be wound to a smaller outside diameter. This winding operation will reduce the size of the outside diameter of the spring so that it can be removed from the tubing. The proper size and temper of wire may be determined by experiment. The spring should be well lubricated.

There have been a number of mechanical devices described in Machinery for bending tubing by means of a grooved roller which travels around the periphery of a form plate of the required diameter. The roller is mounted on an arm which is pivoted in the center of the form plate. The groove in the form plate and also in the roller is of a half circular shape so that the two members will completely enclose the tubing at the bending point. The writer has had greater success with this type of bending device by employing a grooved forming block of suitable length in place of the grooved roller.

S. N. Bacon

DRILLING DEEP HOLES WITH SMALL DRILLS

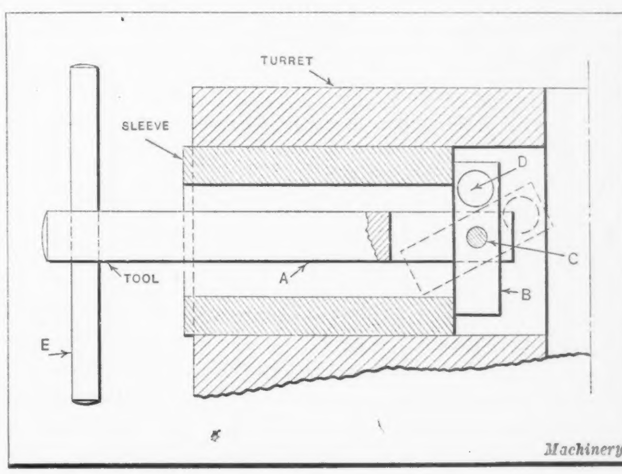
The writer recently had to drill a large number of holes 1/8 inch in diameter to a depth of 6 inches. Considerable trouble was experienced due to drill breakage, which usually occurred when the drill had reached about one-third the required depth. As an experiment, the drill was sharpened slightly off center so that one lip was longer than the other. This made the hole slightly larger than the diameter of the drill, thus providing sufficient clearance to prevent the binding or gripping of the drill in the hole. This method might also be used in some cases to prevent center drills from breaking.

Elam Whitney

TOOL FOR REMOVING SLEEVES FROM LATHE TURRET

In a certain shop considerable trouble was experienced at times in removing plain sleeves, reducing bushings, etc., from the holes in the lathe turret. Hook-pointed tools and screwdrivers were brought into service for the purpose of prying out the pieces but such tools did not prove very satisfactory, mainly because the pull was exerted on one side of the sleeve.

The bushing removing tool shown in the accompanying illustration was finally made up. As this tool proved very satisfactory, it may be of interest to others who experience trouble in removing small bushings from the tool holes in lathe turrets. The end piece *B* swivels loosely on pin *C* in



Tool for removing Sleeves or Bushings

a slot cut in body *A*. The length of piece *B* is slightly less than the diameter of the bushing hole in the turret. A hole *D* drilled in one end of *B* causes this part to be unbalanced, so that it will normally assume an upright position in the end of the tool when the handle *E* is held in the vertical position. The dotted lines show the position of part *B* while it is being inserted in the bushing.

Rosemount, Montreal, Canada Harry Moore

Questions and Answers

SCREENS FOR SAND-BLAST ABRASIVES

E. C. A.—In connection with the screening of sand for sand-blasting apparatus, what does a No. 10 mesh signify? What are the number of meshes per inch, and how is the sand generally graded?

A.—In reference to screens for sand-blast abrasives, the number of the mesh gives the number of openings to the linear inch. For example, No. 10 mesh means that there are ten openings or meshes to the inch, or one hundred openings to the square inch. A No. 8 mesh would have sixty-four openings to the square inch, etc.

The Pangborn Corporation informs us that there seems to be no standard of usage in the grading of sand for sand-blast apparatus, but taking the ocean sands largely used in the eastern states, they would be graded about as follows:

Sand No.	Passes Screen	Remains on Screen
1	20 mesh	40 mesh
2	14 mesh	20 mesh
3	8 mesh	14 mesh
4	5 mesh	8 mesh

The weight of the wire used for the screens is governed by the weight and character of the material to be screened, so that the size or gage of the wire often varies for the same number of screen, and this, in turn, somewhat determines the size of the openings or meshes. The nature of the sand-blast apparatus is such that precise grading is not necessary, and therefore a variation in the weight of the wire is not of great importance, so that individual requirements at the screening plant in this respect may be met without difficulty. For material that requires accurate grading, the size of the opening or space of the mesh would have to be more carefully considered and determined. In this connection catalogue No. 40 of the W. S. Tylor Co., of Cleveland, Ohio, will prove of interest and value, as a general reference.

MEANING OF "THREADS PER INCH" AS APPLIED TO MULTIPLE SCREWS

R. M. G.—What is the correct meaning of the term "number of threads per inch" as applied to a worm? This term has been used in our plant to mean the number of threads which would be cut in each inch along a longitudinal section of the worm; that is, a worm of 1/3 inch pitch would have three threads per inch, irrespective of whether it was a single-, double-, or quadruple-threaded worm. Is this correct, or should the meaning of the term be the same as when applied to a screw, a double-threaded worm of 1/3 inch pitch having 1½ threads per inch, a quadruple-threaded worm of 1/3 inch pitch having ¾ of a thread per inch, etc.?

A.—It is unfortunate that certain expressions, such as the one referred to, have never been standardized. We believe that for all multiple threads, it is the general practice to give that number which indicates the number of threads per inch corresponding to the lead instead of the number corresponding to the pitch. Perhaps confusion would be avoided if the number of threads per inch were not mentioned in connection with multiple threads, the lead being given instead.

One method of specifying, say, a double-thread screw having three threads per inch is as follows: "Three threads per inch, double." This means that the screw has a lead of one-third inch and a pitch of one-sixth inch, but the very fact that the expression requires explanation indicates that it is not very good. A better way of designating this thread is as follows: "One-third inch lead, one-sixth inch pitch, double thread." Still another expression that might be used indicates just what is meant, by reference to the lathe gearing. Thus the thread previously mentioned could be designated as follows: "Double thread, lathe geared for three threads per inch."

CAN A DEFECTIVE PATENT BE REISSUED?

C. N. T.—I have a patent that has fourteen of the seventeen years for which it was granted yet to run. The specification does not properly describe the invention nor does the drawing sufficiently illustrate it. I have been advised that a reissue of the patent to correct these defects can in all probability be obtained. What is meant by a "reissue," and will it grant me protection for seventeen years from the time it is allowed?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

If a patent is inoperative or invalid by reason of a defective or insufficient specification or drawing, or by reason of the patentee claiming as his own invention more than he had a right to claim as new, and if the error arose through inadvertence, accident, or mistake, and without fraudulent or deceptive intention, the original patent may be surrendered, and new specifications and drawings submitted that correctly describe the invention, together with the government fee required. Then, if on examination the application is found to be in proper form, a new patent will be issued, but only for the unexpired part of the seventeen years for which the patent was originally granted. The life of a patent can be extended only by a special act of Congress, and cases in which this has been done are rare. No new matter may be introduced in a reissue application, nor can the claims be broadened beyond their original scope. Failure of the inventor to claim in his original application all to which he might have been entitled is held in fact to be an abandonment thereof, and its dedication to the public.

WEIGHT OF FLYWHEEL

A. J.—Owing to lack of space, I must replace a 17½-inch flywheel on a small gasoline engine by a 12-inch flywheel. How much does the weight of the rim of the smaller flywheel need to be increased in order to have the same effect as the large flywheel?

A.—According to the formula given in MACHINERY'S HANDBOOK, page 288, the total energy stored in a flywheel is

$$E = \frac{Wv^2}{64.32}$$

in which

E = total energy of flywheel, in foot-pounds;
W = weight of flywheel rim, in pounds; and
v = velocity at mean radius of flywheel rim, in feet per second.

As the energy stored in both flywheels is to be the same, and as the velocity at the mean radius of the flywheel rim is proportionate to the mean diameters of the flywheels, the problem can be solved by the following calculation (assuming, for the sake of simplicity that the diameters given in the problem are mean rim diameters):

$$W_l \times 17.5^2 = W_s \times 12^2$$

$$W_s = \frac{W_l \times 17.5^2}{12^2} = 2.13W_l$$

in which

W_l = weight of large flywheel rim, in pounds; and
W_s = weight of small flywheel rim, in pounds.

Expressed in words, the rim of the small flywheel should weigh approximately 2.13 times the weight of the rim of the larger flywheel.

Drawing a Deep Wide-flanged Shell

By FRANK LUX

THE description of the dies here illustrated was prompted by a query submitted to the How and Why Department of MACHINERY, some time ago. Dies for producing deep drawn work having a flange may be designed along two different lines. The shape of the work, of course, determines the type of die to be used. If the flange is not too large, the work can be blanked to size and then drawn, starting with a push-through die for the first drawing operation, which produces a cup. The succeeding drawing operations reduce the diameter of the work and gradually form the flange. The dies shown in June, 1920, MACHINERY, on page 964 are typical of this design.

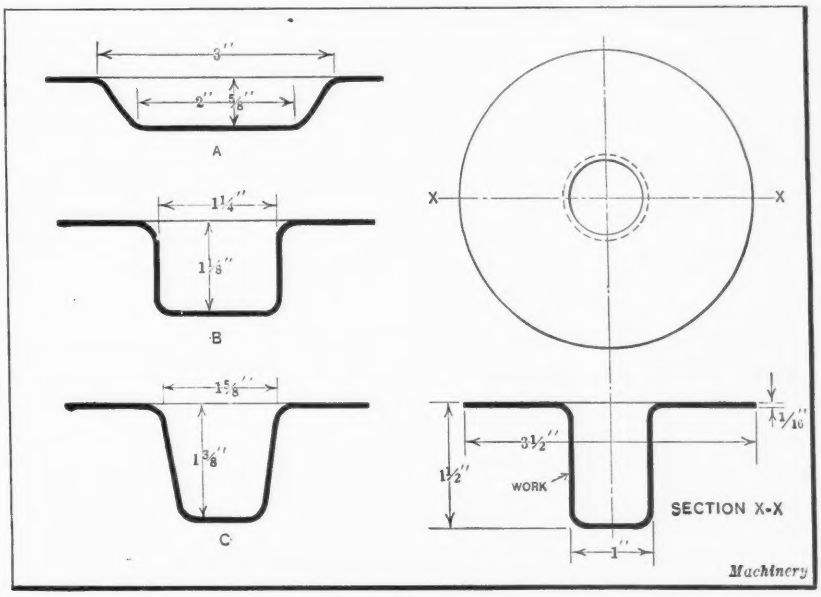


Fig. 1. Successive Steps in drawing a Wide-flanged Shell

A somewhat different line of dies must be used for work having a large flange like that described in the query referred to (see the right-hand view, Fig. 1) in order to prevent wrinkling when the flange is being formed. In laying out the dies for this piece of work, the first step is to determine the amount of draw for each operation and the number of operations required.

The approximate size of the blank is first determined, and as the final size of the work is a known factor it is then possible to lay out the blank size and the finished work on paper. The various drawing operations can next be planned and the shape of the work after each operation sketched in accordingly. This naturally requires knowledge of drawing practice based on experience. Each piece of work to be drawn requires a separate lay-out and the method of procedure is naturally based on the equipment available. For instance, it is necessary to know whether a single- or double-action press is to be used and what the capacity of the press is in tons. Definite knowledge of the material to be drawn is perhaps the most important factor, because the amount of drawing to be accomplished in each operation is governed by the nature of the material. Some materials draw very readily, while others have poor drawing qualities.

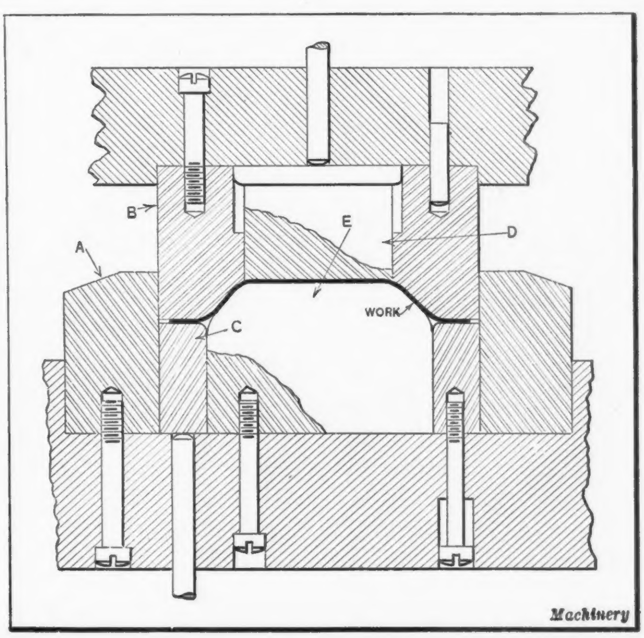


Fig. 2. Blanking and Drawing Die for First Operation

The lay-outs of the dies required for drawing the piece of work shown in Fig. 1 are illustrated in Figs. 2 to 5. It must be remembered that these illustrations are not intended to be actual working drawings but merely to show the best general design dictated by experience and modern practice. They are, however, similar to dies designed and successfully employed by the writer.

The sequence of the drawing operations as they would be planned by the writer for this work is shown in Fig. 1. The dimensions of the finished piece of work are shown in the sectional view in the lower right-hand corner, while the shape of the work after each of the first three drawing operations is shown at *A*, *B*, and *C*, respectively. The dimensions given show the amount of draw in each operation. The fourth drawing operation brings the shell to the desired diameter and length. The size of the blank is determined by the use of tables given on page 980 in MACHINERY'S HANDBOOK. A certain amount of stock is allowed for a final trimming operation, as it is apparent that on deep drawn work the outside diameter of the flange would not be uniform but would have an irregular edge that requires trimming.

The die for the blanking and first drawing operation is shown in Fig. 2. The die *A* and punch *B* blank the work to the correct diameter on the downward stroke of the press and form it to the shape shown by the heavy black line. The work is held securely against the punch by a pressure-ring *C* while the forming is being done, thus preventing wrinkling. Pressure is also exerted on the stock by a pressure-plate *D* acting against block *E*. As the punch is withdrawn, the work is ejected by the pressure-ring *C*, should it have a tendency to stick on the forming block *E*. When it sticks to punch *B* it is stripped by the pressure-plate *D*. If it were desired to blank the work to size in a previous operation, the die would be of similar construction except that the work would then

be located in a nest on the die-block A.

The die for the second operation, shown in Fig. 3, differs somewhat in principle from the one just described. The work A is located on a pressure-ring B, which is a sliding fit on the forming punch C. Spring pressure is applied to ring B through the pressure-pins D, which are connected with heavy coil springs or with a rubber cushion under the bolster plate. The forming die E is located in a punch-holder F, and as the ram of the press is brought down die E grips the work against the pressure-ring which moves downward under pressure and reduces the diameter of the work as indicated by the dotted lines G. It will be seen that the flange is considerably enlarged by this operation.

The die used for the next drawing operation is shown in Fig. 4. This differs from the dies previously described in that its action is more that of sizing than drawing. The work A is located on the top of die B. The punch C fits down into the work and forces it into the hole in the die, stretching out the drawn part, as shown by the dotted lines at D. As the punch reaches the end of its stroke the flange is flattened out between die B and plate E, which is located in punch-holder F.

The final drawing operation is simple, and is performed by a die of the same type as that shown in Fig. 4. After the work has been completely drawn, the flange is trimmed to the required diameter by the die shown in Fig. 5. The work A is located in the block B, which serves as a punch for trimming the flange. The punch-holder is provided with a die C which trims the work to size on the downward stroke of the press. A pressure-plate D holds the work firmly while the trimming is being accomplished. On the upward stroke, stripper E strips the flash F from the punch.

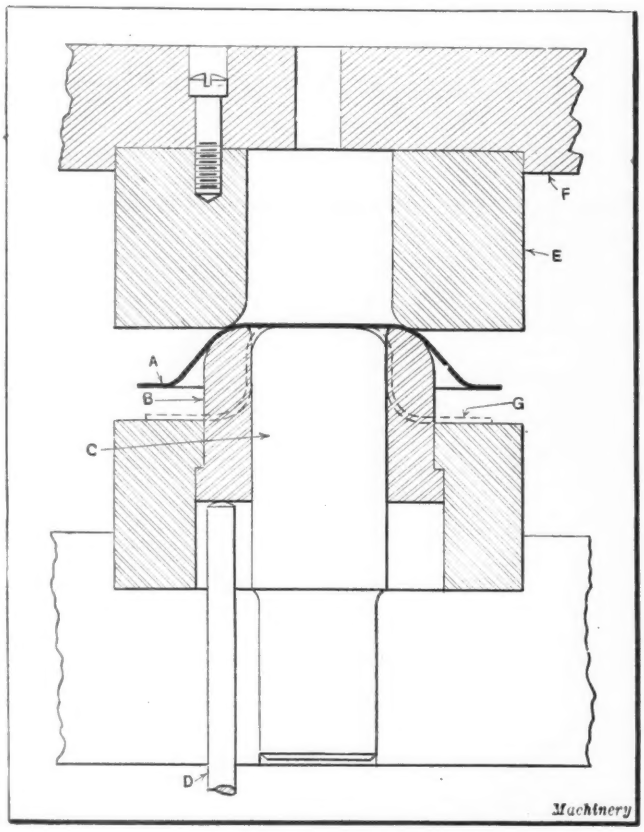


Fig. 3. Drawing Die for Second Operation

THE MACHINE TOOL INDUSTRY IN 1921

The Department of Commerce announces that 349 shops reported to the Bureau of Census that they produced machine tools to a total value of $5000 or more in 1921. Of these shops 98 were located in Ohio, 37 in Massachusetts, 29 in Connecticut, 28 in New York, 25 in Michigan, 24 in Pennsylvania, 23 in Illinois, 17 in Wisconsin, 15 in Indiana, 12 in New Jersey, 12 in Rhode Island, 7 in Missouri, 7 in Vermont, 6 in Kentucky, 3 in New Hampshire, 2 in Minnesota, and 1 each in California, Delaware, Iowa, and Maryland. In 1919 there were 385 shops reporting as builders of machine tools. The smaller number in 1921 is explained by the fact that a number of plants reporting in 1919 had gone out of the machine tool business in 1921.

Considerable fluctuations are noted in the number of wage earners employed in different months during the year. In January, 1921, the month of maximum employment, there were 36,552 wage earners; and in November, the month of minimum employment, only 14,773. The average number employed in 1921 was 21,321 as compared with 53,111 in 1919. The wage payments decreased from 66,000,000 in 1919 to approximately 25,000,000 in 1921. The salaried employes decreased from 8519 in 1919 to 4550 in 1921, and the amount of salaries from about 18,000,000 to 12,000,000.

* * *

A committee composed of members of the four founder engineering societies—the civil, mechanical, electrical, and mining engineers—is cooperating with the national museum of the Smithsonian Institution at Washington in formulating a plan for a National Museum of Engineering and Industry similar to the foreign museums of this type in London, Paris, and Munich.

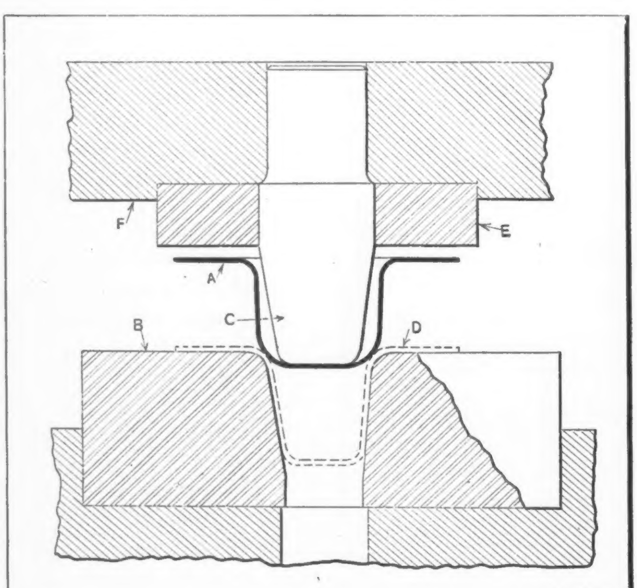


Fig. 4. Die for Fourth Operation on Deep-drawn Shell

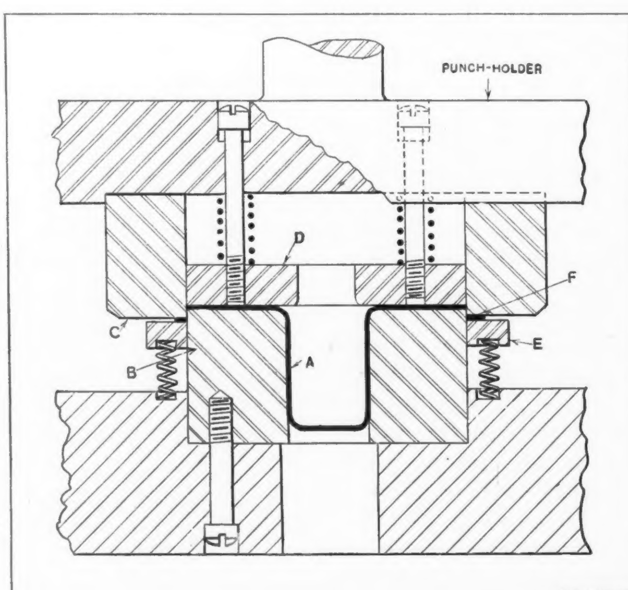


Fig. 5. Die for trimming Flange of Deep-drawn Shell

INDUSTRIAL CONDITIONS IN GERMANY

From MACHINERY'S Special Correspondent

Berlin, January 6, 1923

Owing to the unsettled conditions, it is difficult to present an accurate view of industrial conditions, because they change from day to day. The present letter records conditions as they were at the end of the past year.

The machine industry had a relatively good year in 1922 in the locomotive, machine tool, and agricultural machinery fields. In other machine-building fields, however, the exports scarcely reached one-half the pre-war volume. From January to October the exports of machine tools amounted to approximately 56,850 tons, which averages about 70 per cent of the exports for the same period in 1913. The imports of machine tools during January to October, 1922, amounted to about 1400 tons. The prices of machine tools, as expressed in marks, are constantly rising, but it is practically impossible to give any comparison with prices in other countries, as the rate of exchange varies from day to day.

One of the leading German machine tool builders, whose annual report may be considered typical for many machine tool companies, states that there are abundant orders on hand—enough to keep the company's plant occupied until next summer. The domestic orders, however, are rapidly diminishing, as domestic buyers are no longer able to pay the prices as now expressed in marks. This constant change in the value of the mark causes great difficulty in the manufacturing field, because the expenditures each month, as expressed in marks, always exceed the receipts, the latter being based on a value of the mark no longer in existence. Many manufacturers for that reason are heavily indebted to the banks. As it is practically impossible to foresee the losses due to sudden fluctuations in the value of the mark, German manufacturers are looking toward the future with great apprehension.

Wages and Labor Conditions

It is of little value to mention wages, in marks, because they vary constantly and there is no standard of comparison. The buying power of wages, however, may be indicated by a comparison. In November, wages of skilled and unskilled labor in the metal-working industries, in marks, were from 255 to 386 times as large as in 1914, but the cost of living had increased 580 times. A skilled man now obtains only 7 per cent more than an unskilled man, according to the fixed union rates. This will greatly endanger the future development of the industries, because many young men now refuse to learn a trade, their earning capacity being practically the same whether they are skilled or unskilled. Before the war, skilled men received about 40 per cent more than unskilled men.

The return on capital investment is even more out of proportion with pre-war figures than are wages. One of the large machine tool builders, now paying a dividend of 30 per cent on its pre-war capital, in reality pays only 0.05 per cent, because of the decreased purchasing power of the mark.

The general German labor union, in its annual report, states that it had a membership at the end of 1921 of 7,752,000, of whom 5,896,000 were men. In addition to this union, there are several smaller unions having a membership of approximately 1,250,000, so that in total about 9,000,000 workers are now organized in labor unions, which are said to be the actual rulers of Germany.

The efficiency of the workers, it is said, leaves much to be desired, and in some cases the rules limit the output and the efficiency of the machines employed, even in cases where an increased output would not involve greater effort.

Conditions in Different Industries

While the locomotive industry has been fairly well supplied with work during the past year, the prospects in this field are not very good. Sales to foreign customers are difficult on account of the unstable exchange rate. The shipbuilding industry is in difficulties due to sudden great increases in costs of materials. The bicycle industry is well employed, but the exports have recently been curtailed. The optical and precision instrument industries are well provided with work.

In all the large centers there is a great scarcity of coal and raw materials. The German state railways are buying foreign coal for the coming year's supply, and the iron and steel industry is particularly handicapped by the lack of fuel. Of the total amount of iron ore consumed in Germany, 77 per cent is imported.

The exports of locomotives amounted to 92,700 tons during January to October; and of agricultural machinery, 27,800 tons. The exports of locomotives were more than double the exports during a similar period in 1913, while the exports of agricultural machines were about 80 per cent of the exports in 1913.

Russian Trade

A great deal has been written about the trade between Germany and Russia. The rebuilding of Russia's industrial life involves a big credit problem, which cannot be mastered by Germany alone. Business with the Soviet Government is now very much at a standstill, because of the difficulty of financing this work. Some of the large iron and steel concerns in Germany have secured industrial, mining, and agricultural concessions in Russia. The preparatory work on a general German-Russian commercial treaty is proceeding rapidly, and considerable benefits are expected from it. An Austrian-Russian company has been founded with a view to supplying Russia with manufactured goods, presumably in exchange for raw materials. At present, however, ideas are abundant, while real achievements are lacking.

* * *

ANNUAL MEETING OF AUTOMOTIVE ENGINEERS

During the annual meeting of the Automotive Engineers held in New York City, January 9 to 12, papers were presented covering many phases of automotive engineering. At the Standards Committee meeting many important reports were presented with regard to which action for adoption, revision, or rejection was taken. These reports had previously been published in the journal of the society, so that the members attending the meeting were able to offer carefully thought out suggestions or criticisms. An aeronautic session was held at which several well-known authorities on commercial aircraft presented brief statements on certain fundamental design problems, the solution of which is considered necessary before commercial aviation can progress further.

Professor G. A. Young presented a paper on "Practical Methods of Securing High Compression without Detonation." This paper brought out some interesting results of research work conducted in the laboratory of Purdue University. Thomas Midgley, Jr., read a paper on "Fundamental Laws Governing Detonation," and Stanwood W. Sparrow and S. M. Lee of the Bureau of Standards presented a paper on "Means of Measuring Detonation and Comparing Fuels for Use in High-compression Engines." Robert E. Wilson presented a paper on "The Function of Oil and Fuel in Crankcase Dilution," and C. S. Kegerreis read a paper on "Carburetion of Gasoline and Kerosene."

One entire session was devoted to reports and discussions of the progress made in the fuel research project that was formulated by the Research Department of the society. Two sessions dealing with air-cooled engines were also held, and the body engineering session offered papers of interest to engineers engaged in this phase of automobile building. Copies of the papers presented may be obtained from the Society of Automotive Engineers, 29 W. 39th St., New York City.

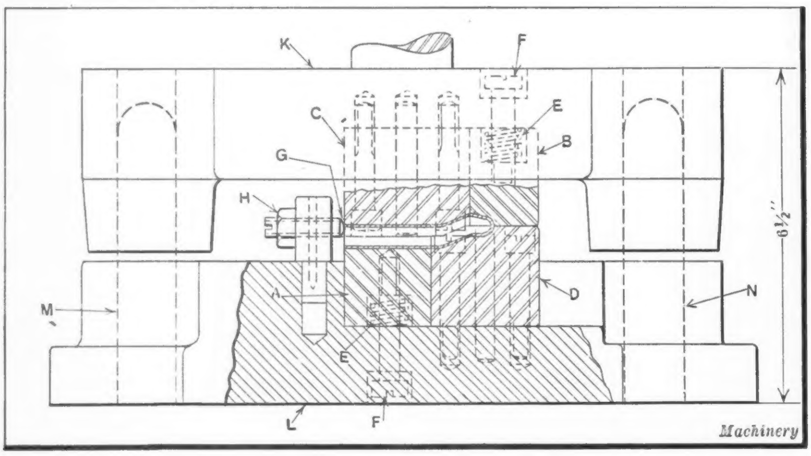


Fig. 1. Die for producing Offset indicated at C, Fig. 2

CORRESPONDENCE AND TRADE LITERATURE FOR MEXICO

The Mexican Chamber of Commerce of the United States, in one of its recent bulletins, emphasizes the necessity for writing all correspondence with Mexico in Spanish. All printed matter sent to Mexico for publicity purposes should also be in Spanish. It is true that the majority of the merchants understand English sufficiently to read the correspondence in this language, but they greatly prefer to deal with an American firm that uses the Spanish language. Mexican merchants are swamped with all kinds of circulars, advertisements, and literature from the United States, mostly in English. A large part of this mail goes directly into the waste basket, and, because of the volume of it, even a really interesting sales letter is given little attention, in view of the great mass of matter printed in English arriving in the same mail. Generally speaking, traveling agents or representatives are the most effective means of securing business in Mexico.

* * *

Two factors have particularly aided in increasing the present demand for iron and steel products. The continuation in the building boom this spring, forecast by the upward swing in the sale of fabricated structural steel, is one, and the heavy buying of rolling stock and other equipment by the railroads is another. It is expected that the railroads will spend $700,000,000 for various kinds of equipment and improvement in 1923. The average for the last ten years has been less than $500,000,000 a year. On December 31 there were unfilled orders for nearly 1600 locomotives, and additional orders for both locomotives and cars have been placed during the month of January and are likely to continue to be placed during the early part of the year. The activity in the locomotive and car shops is evidenced by orders for machine tools and shop equipment, as well as forgings and castings.

BENDING OVERFLOW PIPE FOR AUTOMOBILE RADIATOR

By J. A. HONEGGER

The ⅜-inch radiator overflow pipe shown in Fig. 2 is bent to the shape indicated in three operations. The bending equipment consists of the fixture shown in Fig. 4, and the bending dies shown in Figs. 1 and 5. The fixture shown in Fig. 4 forms the 3⅛-inch radius bend at *A*, Fig. 2. The die shown in Fig. 5 produces the ¾-inch radius bend indicated at *B*, Fig. 2, while the die shown in Fig. 1 produces the 3/16-inch offset indicated at *C*, Fig. 2. For the first operation the straight tubing or pipe is passed between rollers *A* and *B*, Fig. 4, and under the clamp *C*. Springs, located in counterbored holes in the clamp, serve to hold the clamping jaws open when nut *G* is loosened. The tubing is pushed through the opening in the clamp until it rests against stop *E*, which is properly adjusted by nut *F*.

When the tubing or pipe is in place, the clamp is tightened by turning nut *G*. By operating lever *H*, roller *B* is caused to rotate about the periphery of stationary roller *A* and thus bend the pipe to the required radius. Lever *H* is provided with a lug *K* which slides or rides on track *L*. This construction gives the lever adequate support and keeps the bending rolls in proper alignment. Stop *M* is adjusted to allow an over movement of lever *H*, as the pipe has a tendency to spring back after being bent. It will be noted that the roller *A* is prevented from turning by four fillister-head screws, one of which is shown at *N*. Stop *P* is adjusted to bring the hole or opening between rollers *A* and *B* into alignment with the hole in clamp *C* so that the work can be easily inserted between the two bending rolls.

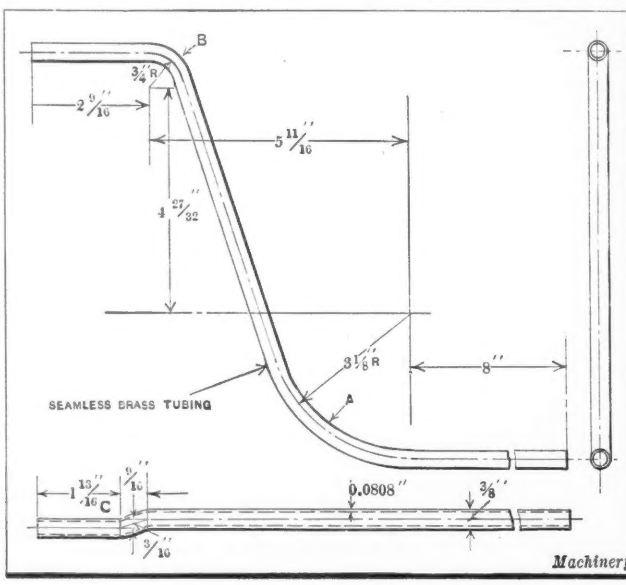


Fig. 2. Details of Overflow Pipe

After removing the work from the fixture shown in Fig. 4, it is placed in the die, Fig. 5, which forms the bend *B*, Fig. 2. The grooves formed in the spring block *A*, Fig. 5, fixed block *B*, and the outboard support *C*, and the stop *D* serve to locate the work. Normally the groove in spring block *A* is located ⅛ inch higher than the groove in block *B*.

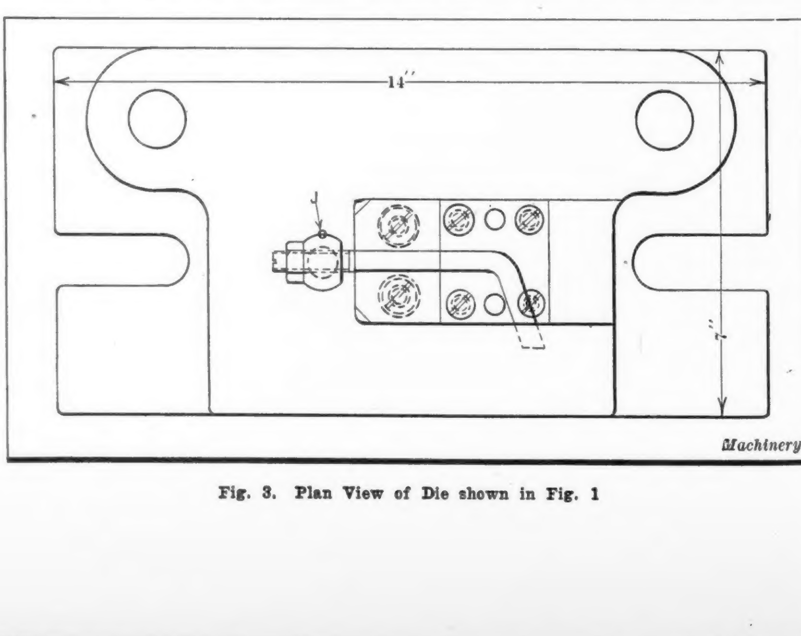


Fig. 3. Plan View of Die shown in Fig. 1

This position is maintained by the upward pressure exerted by springs *E* and the limiting action of screws *F*. Bracket *C*, besides acting as a support, also performs the function of a guide block, to prevent the bend at *B*, Fig. 2, from being bent to one side, or out of parallel with the bend at *A*.

Referring to Fig. 5, block *G* is provided with a groove similar to that in block *A*. As block or punch *G* descends, the groove closes over the tube in spring block *A* until the flat faces of both blocks *A* and *G* meet. Block *A* then recedes 1/8 inch into the die-shoe, acting against the pressure of springs *E*. This insures a positive grip on the tube before the bending commences. Further downward movement of the forming punch bends the tubing to the shape indicated. A slot is provided in the punch-holder at *H* to give sufficient clearance for the end of the tube. On the return stroke of the press, block *A* regains its normal position through the action of springs *E*. This block is guided in both its up and down movements by pin *J*. The punch and die are aligned by pins *K* and *L*.

The die employed for the final bending operation which forms the offset at *C*, Fig. 2, is shown in Fig. 1. Normally, spring blocks *A* and *B* are level with blocks *C* and *D*, this position being maintained by springs *E* and stop-screws *F*. The bend produced in the second operation is placed in the groove in blocks *A* and *D*, the end of the tube resting against stop *G*, which is adjusted by nut *H*. The stud which holds this stop is prevented from turning by the pin *J* shown in the plan view of the die, Fig. 3. On the downward stroke, punches *B* and *C* close over the tubing so that punch *B* rests on the upper face of block *D*. Continued downward movement causes punch *B* to recede into punch-holder *K*, while block *A* recedes into die-shoe *L*. This forces the tube to assume the form of the grooves in blocks *C* and *D*. The punch and die are aligned by pillars *M* and *N*.

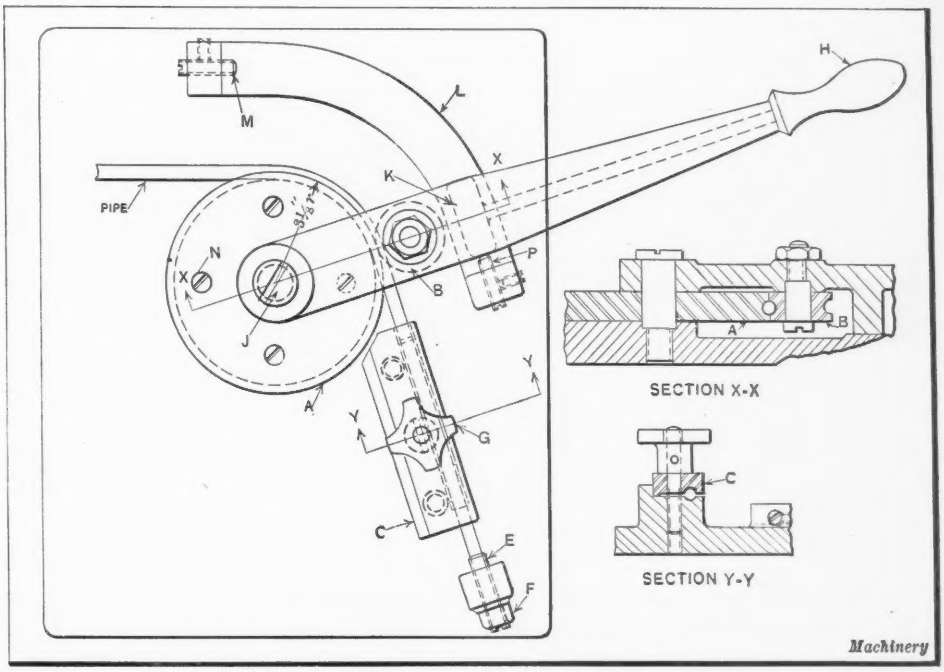


Fig. 4. Fixture for making Bend shown at A, Fig. 2

* * *

Labor conditions throughout the country are improving. There is practically no unemployment at present except when due to purely local conditions; and in certain localities, especially in the steel districts, there is an acute scarcity of labor—especially of unskilled men. In the machine-building industries, there is a scarcity of skilled labor, and as the conditions in the industry improve, the shortage of machinists and toolmakers will be severely felt by manufacturers. For the first time in two years the United States employment service announces that there are more jobs registered with state and municipal agencies than there are workers. A year ago there were practically two workers registered for every job. A similar indication of increased industrial activity is reported by the employment department of the American Association of Engineers, which states that engineering employment improved month by month during the past year in the technical and engineering fields. On some railroads the shopmen's strike is unsettled, while in other cases the old employes have gone back to work.

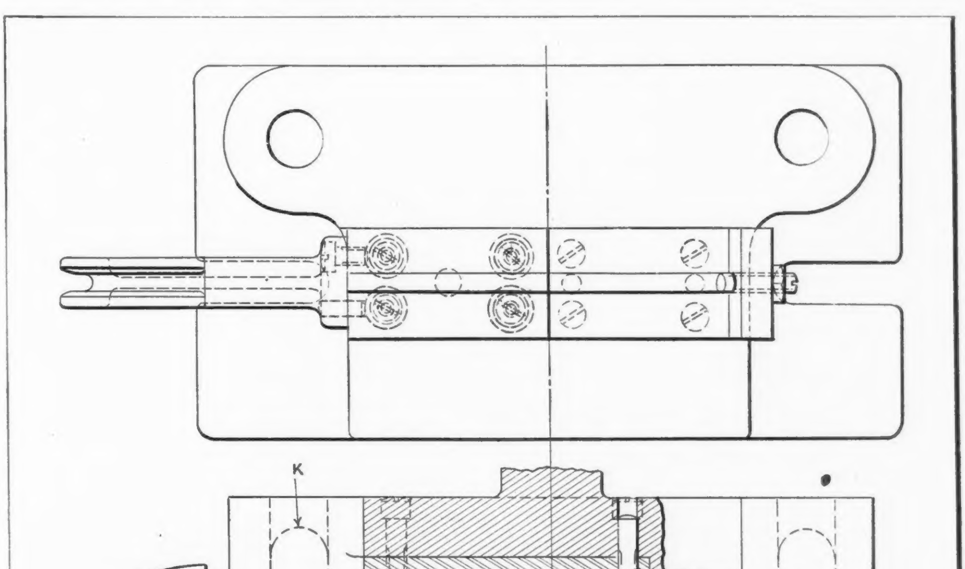


Fig. 5. Die for forming Bend B, Fig. 2

CHUCKING OVER-SIZE PISTONS

A number of interesting chucking devices are employed in the plant of the Houpert Machine Co., Long Island City, in machining over-size pistons. Although this company is prepared to manufacture pistons on a commercial basis by means of automatic machinery, the manufacturing is not carried beyond the semi-finished stage, the final finishing operations being performed on pistons taken from stock whenever a cylinder of any particular size or make is to be refitted. Some of the chucking devices used for this work are shown in the accompanying illustrations.

The semi-finished pistons with the piston-hole already machined are chucked in the manner illustrated in Fig. 1, for refacing the skirt end, as special requirements may demand. This pot chuck is shown attached to the spindle of a Reed lathe, and the means employed for holding the work assure that the end will be faced square with the piston-pin hole. The piston is placed loosely in the chuck, the three set-screws being loosened, and is held square by means of the squaring device carried in the tailstock of the lathe. This consists of a short slabbed bar *A* which is held vertically, as shown, and brought to bear against the end of the piston. The three set-screws are then brought up lightly against the periphery of the work to hold the location thus secured, and handle *B* is moved forward, rocking the collar *C* and advancing two eye-bolts, which are located diametrically opposite each other in the walls of the chuck. One of these eye-bolts is shown at *D*.

As soon as the bolts have advanced far enough, a special arbor *E* is passed through them and through the piston-pin hole, and the handle *B* is released, which permits springs located on the eye-bolts at the rear end to draw back and firmly hold the arbor in the V-blocks. This is the position shown in the illustration. The V-blocks have hardened steel faces, and the arbor has a special feature for tightening it within the piston-pin hole, consisting of a key, set into the arbor, which is tightened by a headless set-screw. The arbor is so placed that this key is in line with the V-blocks, so that tightening the arbor in place causes the key to bind in a horizontal plane within the hole. The tightening will not then have a tendency to destroy the setting previously obtained by means of the tailstock and radial set-screws. The springs that draw the eye-bolts back are sufficiently strong to hold the piston securely in its aligned position, which assures a positive location from which the end of the piston can be accurately faced parallel with the piston-pin hole.

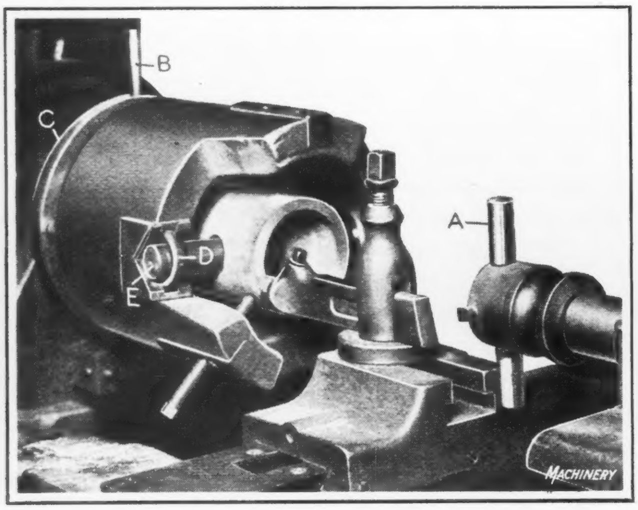


Fig. 1. Chuck for holding Semi-finished Pistons while refacing Ends

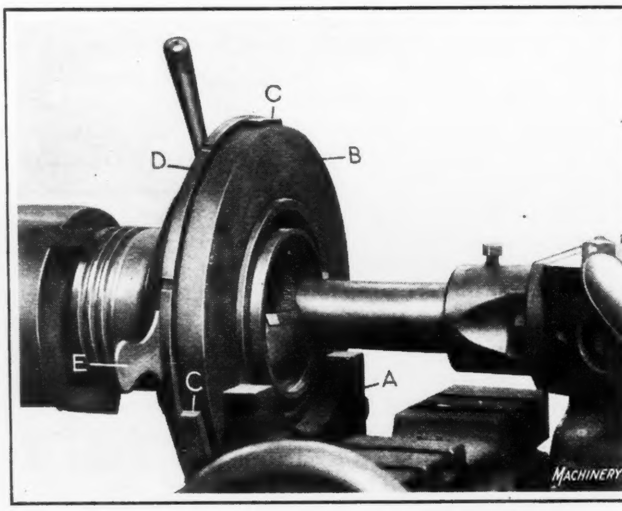


Fig. 2. Cam-operated Steadyrest for Use in machining Over-size Pistons

Another piston chucking arrangement is illustrated in Fig. 2. Here a Warner & Swasey turret lathe is shown, on the ways of which a special cam-operated steadyrest is attached. In this case the steadyrest is used chiefly in touching up the ends of finished pistons which may not have passed inspection for squareness of end, or which may require some minor correction. The operation shown is that of refacing the skirt end of a finished piston. The work is held in an ordinary jaw chuck, and the steadyrest used to support the outer end and locate it squarely while the operations are being performed.

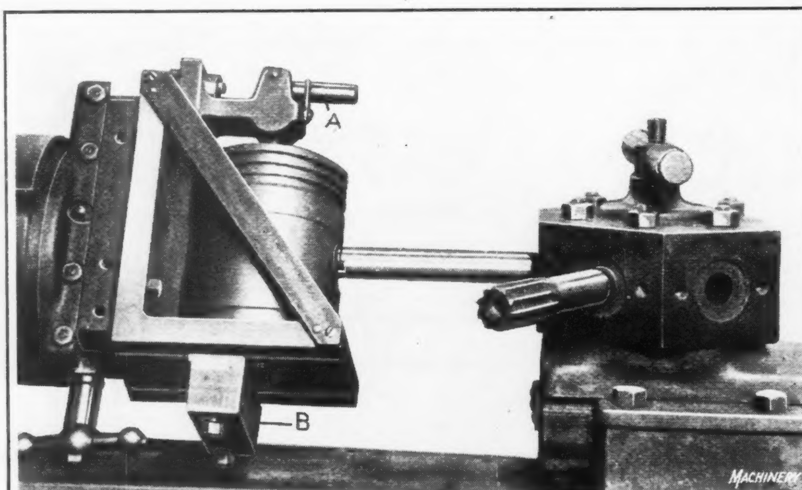


Fig. 3. Piston Fixture with Cross-slide Adjustment Feature

The steadyrest is attached to a heavy bridge iron *A* which is accurately fitted to the ways of the lathe. The body *B* of the steadyrest carries three radial jaws *C*, the inner ends of which are formed to fit the curvature of the piston so that the work may revolve freely while it is being held in perfect alignment. These jaws operate in three eccentric slots in the cam-plate *D*. The jaws may be quickly advanced against the work by means of the handle shown, in which position they are locked by a binder ring which is threaded on a shoulder of the body and operated by means of the finger-lever *E*.

A third piston chucking set-up is illustrated in Fig. 3. This device is somewhat similar in general construction to that in common use in automobile repair shops. It consists of an angle-plate fixture. The piston is seated on a

locating plate of the proper diameter and is secured at the closed end by a cam-operated clamp. The cam is tightened by the small lever *A*, which brings the clamp against the center of the closed end, where it is held by the link shown engaging the handle. A ballast *B* is attached to the base of the angle-plate as shown. This fixture is used extensively for reboring and finish-reaming piston-pin holes, but is not used in the regular manufacturing processes; in the latter case, these operations are performed by the use of an automatic machine.

The centering feature of this fixture is simple, consisting of the cross-slide of a compound rest, which permits the work to be accurately located by means of the cross-feed operating handle. The slide is provided with a gib that is adjusted tightly against the movable member of the slide, so that after the center adjustment has been obtained there is no danger of the work changing position during the operation.

* * *

DIE FOR SPECIAL WASHER

By C. E. STEVENS

The original method of producing the washer shown completed at *A*, Fig. 1, was to pierce and blank the piece in one operation and form or bend the ears in a second operation. The cost of the forming operation was many times that of the piercing and blanking one, because, in forming, it was necessary for the operator to handle each washer separately. In order to eliminate the second operation

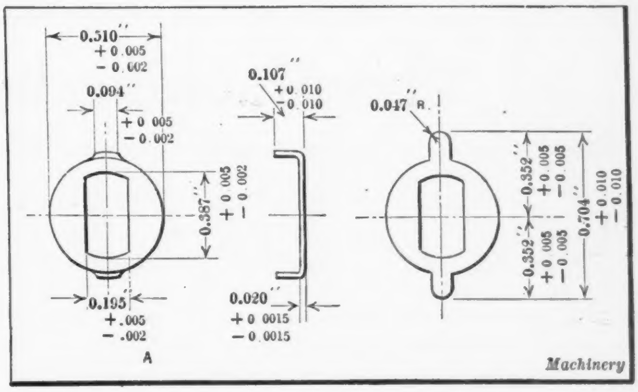


Fig. 1. Details of Special Washer

the die shown in Fig. 2 was designed. This die produces one complete washer at each stroke of the press. The die-block *A* is of tool steel, and is fastened to the cast-iron die-shoe *B* by three 1/4-inch fillister-head screws, four 1/4-inch hexagonal-head cap-screws and two dowel-pins. The fillister-head screws are screwed into die-block *A* from the bottom, while the cap-screws enter the castings from the top side. The cap-screws also serve to hold the stripper *C* in place. Spacers or strips 1/16-inch thick are placed between the die-block and the stripper to give the clearance required to permit the stock to be fed through the dies. One of the spacer strips *D* extends beyond the end of the stripper plate, and acts as a guide for the stock when entering the die.

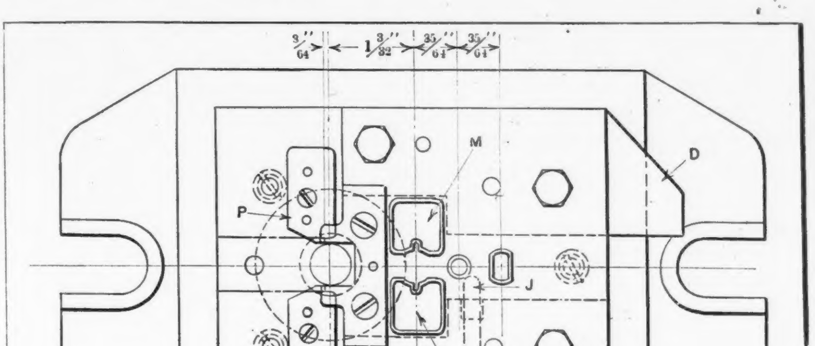


Fig. 2. Die for producing Washer shown in Fig. 1 at One Stroke of the Press

The punches are set in a machine-steel part *E* and are riveted over at the top of this member. The part *E* is mounted on a cast-iron punch-holder *F*, and held in place by four 5/16-inch fillister-head screws and two dowels. The punch *G* and the forming punch *H* are kept from turning by small headless set-screws. The stock is fed into the die against the finger-stop *J*, which is normally held in the outward position by a small coil spring. When starting a new roll of stock, this stop is held in by the operator so that it serves to locate the stock while the elongated hole is pierced by punch *G*. The stock is then fed in so that the pierced hole lines up with the pilot *K*. A second elongated hole for another washer is next pierced by punch *G* while pilot *K* holds the stock in place. The stock is then fed into the third position, and the first step or blank is trimmed by punches *L*, which enter the die member at *M* and *N*. (See upper view). This punch leaves the ears and a small web in the center of the strip as shown at *O*. An idle or blank space is left between punches *L* and *H* to provide ample wall thickness for the die-block between the trimming and forming openings.

When fed in to the final blanking and forming position, the small ears on the work are brought in contact with the locating gages *P* so that the stock is properly centered. The edges of the forming punch *H* which are in contact with the ears are slightly stoned or rounded, while the remaining part is ground to a cutting edge. As this punch descends, the blank is cut free from the web and the ears are bent or formed. It will be noted that punch *H* acts against the spring-backed plunger *Q*. The blank is stripped from punch *H* by the stripper block *R* on the up stroke of the press, after which the blank and web are ejected from the die by compressed air. The stripper *R* is fastened to plate *C* and is made a slip fit on punch *H*.

The Machine-building Industries

ALL authorities on business conditions agree that 1923 opens under favorable auspices. General industrial conditions continue to improve. Contrary to the usual trend at this season, production in the basic industries is gaining. Since July, 1921, when the average production of all industries was lower than at any time in recent years, there has been an almost uninterrupted rise month by month. The production of pig iron is larger than at any time in over two years. The automobile industry shows no signs of seasonal decline, the locomotive plants are busy, the textile industries are unusually active, and building operations are maintained on a great scale, despite the season. This activity is having a far-reaching effect upon many other industries.

Mr. Hoover, in making a forecast of business conditions during 1923, says, "The odds are favorable for 1923; the world begins the year with greater economic strength than a year ago; production and trade are upon a larger and more substantial basis, with the single exception of the sore spot in Central Europe. The healing force of business and commerce has gained substantial ascendency over destructive political and social forces. There is ample reason why there should be continued progress during the coming year."

The Machine Tool Industry

The improvement in the machine tool industry is slow, but definite. The average business for the entire industry is about 35 per cent of capacity, with some fifteen or twenty firms doing considerably better than this. During December about half the machine tool builders had an increase in business of 20 per cent or more. Contrary to usual business experience, the first weeks in January brought a fair volume of business to many tool manufacturers. A few concerns state that business reached a normal level and would be quite satisfactory if it continued at the same rate throughout the year.

One New England manufacturer building a standard line operates at 75 per cent capacity, and another building special machinery runs to capacity and has orders on hand for the next three months; but in many cases the shops are still running on a limited schedule, although stocks are being reduced so that the time is approaching when a resumption of more active manufacturing will become necessary.

One shaper manufacturer finds that his total business for last year averaged about 50 per cent of normal, and a manufacturer of grinding machines sold a larger number in 1922 than in the best year previous to the war. This manufacturer states that if the number of machines sold in 1912 is represented by 100, the sales in 1917 were 300; 1918, 300; 1920, 200; 1921, 95; and 1922, 120. As prices are from 90 to 95 per cent higher than before the war, this means that the actual volume of business in dollars and cents in 1922 was more than double the business of ten years ago. Multiple-spindle drilling machines have been in fair demand for the last two months, both in the sensitive and in the bigger types; and while conditions as recorded may not be as favorable in the case of all machine tool builders, it is generally believed that the latter part of 1923 will see practically a normal business in this field.

Small Tools and Accessories

The small tool business is improving more rapidly than the machine tool business. One of the largest tap manufacturers operates at 60 per cent capacity, and in the Middle West the small tool business is reported to average from 75 to 80 per cent of what might be considered normal. The general practice of taking inventories at the beginning of the year has been responsible for some decrease in orders in this field; but on the other hand, February and March usually bring an increased volume of business. The demand for hacksaws is active, and several manufacturers of this product are running to capacity. Prices for hacksaws, however, are entirely too low, being only about 10 per cent above the pre-war price, which is out of all proportion to the increased cost of materials and labor. The business in hacksaw and cutting-off machinery is not yet anywhere nearly normal, but it is considerably better than a year ago.

The grinding wheel industry operates at about 60 per cent capacity, with prices that are considered satisfactory. The pressed-steel and stamping business runs to capacity in all cases when catering to the automobile field, and to from 50 to 60 per cent capacity when devoted to a general line of business. An important development is taking place in this field in that castings are in many instances being replaced by pressed-steel members, as the latter are lighter, cheaper, and stronger than castings. Gradually, the general substitution of pressed steel for castings, whenever this can be done, will bring a great deal of business to the shops engaged in this line.

Chain manufacturers are active, as would be expected with business flourishing in the automobile field. The demand for bicycle chains is also good, and industrial chain users are placing more orders than formerly. Some of the die-casting shops are operating to capacity, and others have a business far in excess of a year ago. The demand for machinists' precision measuring tools is much better, and micrometer makers do a business of about 50 per cent normal. Magnetic chucks are in greater demand than for nearly three years. Multiple drill heads have a fair sale, and the demand for broaches taxes at least the smaller broach-makers to capacity.

The Automobile Industry

All past records in automobile production were surpassed in 1922. At present, the automobile industry continues to produce in excess of any previous figures for this time of the year, and some of the leading companies are operating nearly at capacity, which ordinarily happens only during the late spring and early summer months. The manufacturers are confronted with transportation, raw material, and labor problems, but so far there has been no noticeable decline in factory operations on this account.

The Iron and Steel Industry

Perhaps the most hopeful sign for the machine tool industry is the activity in the iron and steel field, which always must precede an active demand for machine tools. The decrease in steel production that was expected before the end of the past year did not set in, and there has been no decline in the production of either pig iron, billets, bars, shapes, or plates. Taking steel alone as a criterion, some industrial forecasters see signs of a boom year. This is probably too optimistic a view, but stable conditions are aided by the fact that as the volume of business increases, prices are largely kept in check by the conservative price policies of the larger steel corporations, and unless unforeseen conditions arise, prices will probably continue at their present level for a considerable period. Nevertheless, it is considered wise to place orders for future needs right now, for even though prices remain stable, there may be difficulties about deliveries if the present increase in demand continues.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

The New Tool descriptions in MACHINERY are restricted to the special field the journal covers—machine tools and accessories and other machine shop equipment. The editorial policy is to describe the machine or accessory so as to give the technical reader a definite idea of the design, construction, and function of the machine, of the mechanical principles involved, and of its application.

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Reed-Prentice Planer-type Surface Grinding Machine

A PLANER-TYPE surface grinding machine capable of handling work up to 19¾ inches wide, 15 feet long, and 10 inches high above the magnetic chucks with which the table is provided has been brought out by the Reed-Prentice Co., 677 Cambridge St., Worcester, Mass. From the accompanying illustrations it will be seen that the bed, table, and housings of the machine are the same as in the regular Whitcomb 36-inch heavy-duty planer built by this company. The driving mechanism for the table is also of the standard construction. The cross-rail is of special design, and has mounted on it a Blanchard vertical grinding head, which is driven by a 25-horsepower self-contained motor and equipped with a 20-inch grinding wheel. The machine is primarily designed for grinding cast-iron channels, but it may also be used for many other classes of work, either steel or cast iron.

The handwheel near the bottom of the housing on the front side of the machine is for raising and lowering the cross-rail, to position the grinding wheel properly to suit different heights of work. Accurate vertical movements of the head are obtained by revolving the upper handwheel located on the cross-rail, at the front of the machine. The work is held by means of six magnetic chucks, which have previously been referred to. Each of these chucks has a magnetic surface of 14⅛ by 19¾ inches. There is a cast-iron spacer placed between each chuck, so that the work is supported against the thrust of the wheel for its entire length. Side guides and other spacers are mounted on the cast-iron spacers between the chucks, and at one end of the table a bracket is provided to brace the work against end movement. These parts are necessary to hold the work in place in the event that the supply of electric current to the chucks should be accidentally shut off while the grinding wheel is traveling over the work.

The machine is equipped with a two-speed countershaft for driving the table, the two speeds providing for taking roughing and finishing cuts. The roughing cuts are taken at a table speed of 30 feet per minute, on both the forward and return strokes of the table, while the finishing cuts may be taken at a table speed suited to the requirements.

Angle-irons are fastened around the sides and ends of the table for its entire length and width to support sheet-metal guards. These guards protect the operator from injury and prevent the cutting compound from running on

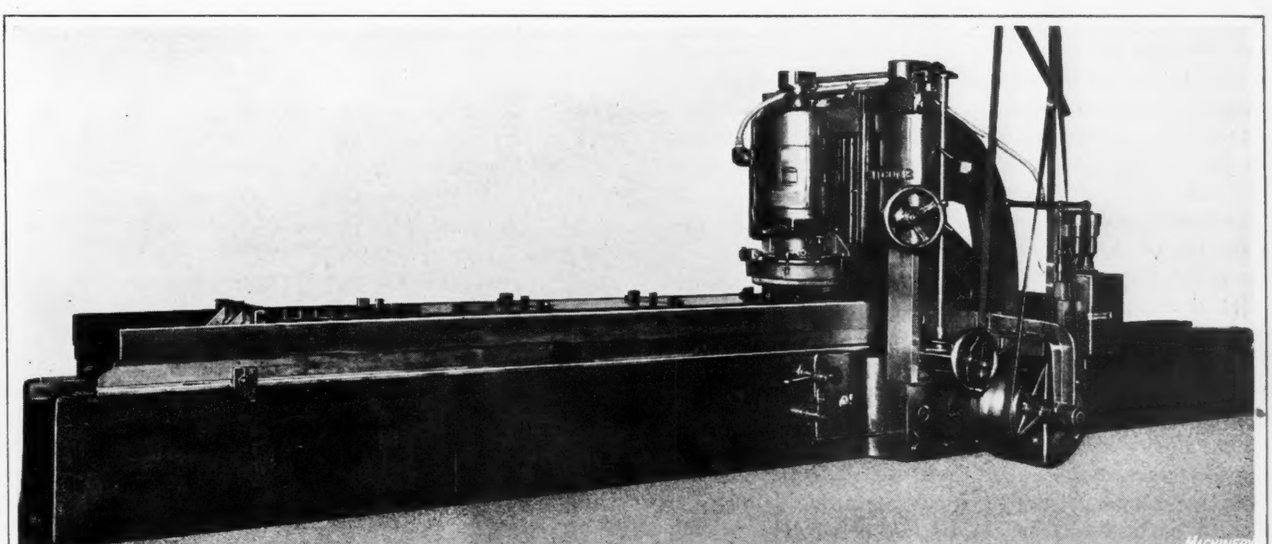


Fig. 1. Reed-Prentice Surface Grinding Machine of the Planer Type for grinding Work up to 15 Feet in Length

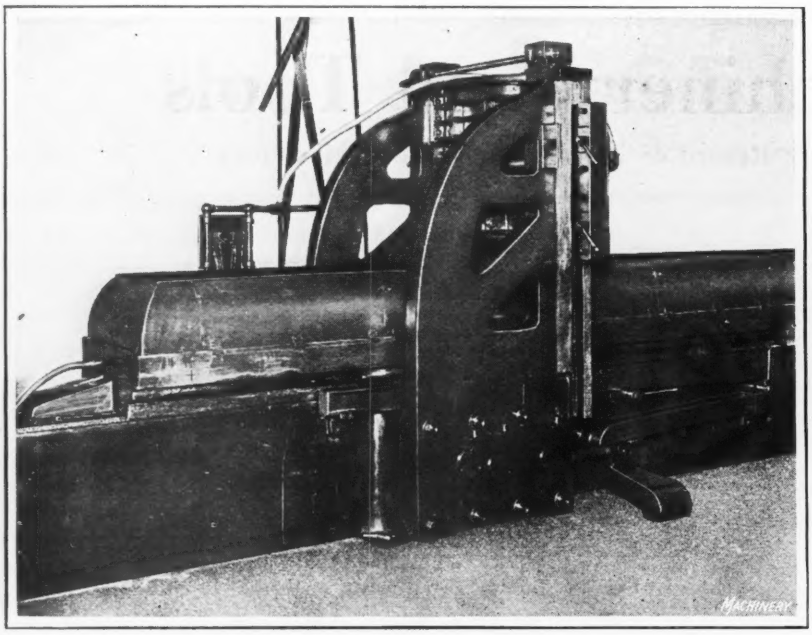


Fig. 2. Rear View of the Planer-type Grinding Machine, showing Method of conveying the Cutting Compound back to the Supply Tank

gears to be shifted from one speed to another while revolving simply from their own momentum, thus eliminating shock and excessive clashing.

The automatic chuck is forged from the solid on the end of the spindle so as to insure rigidity and obtain minimum overhang from the front spindle bearing. The work is gripped or released instantly and, in conjunction with the stock feed, may be fed forward without stopping the machine, by giving a movement to the long lever at the front of the head. A stepped wedge automatically compensates for variations in the size of the work. An extra capacity chuck may be furnished for holding short work of large diameter.

The side carriage clears the chuck and can be moved out of the way to permit the use of short tools on the hexagon turret. Six independent stops are provided on the side carriage for the longitudinal movement. The square turret on the cross-slide is positioned by means of a hardened lock-bolt located directly beneath the cutting tool; the turret is unclamped and the lock-bolt withdrawn by a vertical movement of the lever on top of the turret. The six tool holes in the hexagon turret are fitted with binder bushings, and stock can be passed through them so as to allow the use of short stiff tools in turning long work. The hexagon turret is indexed automatically by the backward movement of the turret-slide, and is locked in the different positions by means of a bolt at the front end of the slide. Independent automatic stops are supplied for each turret face, and the abutment for the stops can be shifted to allow a slight extra movement of the turret. The stops are also arranged to trip the power feed. The side carriage and turret are provided with separate feed-shafts so that each may be operated independently of the other. The feeds to the side carriage can be reversed by operating the knob on the side of the apron.

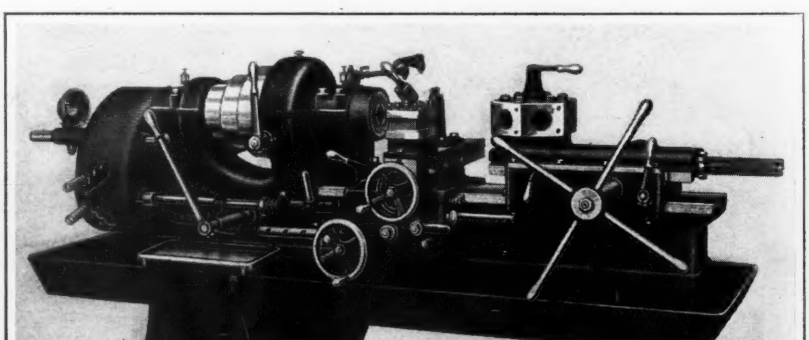
A two-horsepower constant-speed motor running at 1200 revolutions per minute is required for the geared-head machine, and it is recommended that the motor be mounted on the rear side of the head-end leg. For the cone-head machine, a two-horsepower variable-speed motor running at from 500 to 1500 revolutions per minute is preferable. This motor is placed on a pedestal at the rear of the head and belted to the cone pulley. A taper attachment for turning tapers up to 3 inches per foot in lengths of 8 inches, and a chasing attachment for cutting threads from 3 to 72 pitch,

the floor or into the various mechanisms of the machine. The guards were removed from the table at the time the photograph, Fig. 1, was taken, in order to give a better view of the grinding head and the magnetic chucks. On the rear side of the machine, which is illustrated in Fig. 2, there is a spout through which the cutting compound leaves the table and flows through metal troughs to receiving and supply tanks beneath the floor. The cutting compound is delivered to the wheel by a pump in the supply tank, through two 1-inch pipes, one of which conveys the compound to the inside of the grinding wheel and the other to the outside.

CINCINNATI-ACME UNIVERSAL TURRET LATHE

The No. 1 universal hexagon turret lathe here illustrated is an addition to the line of turret machinery manufactured by the Acme Machine Tool Co., Cincinnati, Ohio. The illustration shows this machine with a cone head, but it may also be furnished with an all-geared head. The bar capacity is for work up to 1½ by 9 inches, and the chucking capacity for work up to 18 inches. The head is cast solid with the bed, so as to obtain maximum rigidity and correct alignment of the spindle with the ways of the bed. The driving cone has three steps, and with this type of drive there is a friction single back-gear. The all-geared head provides twelve spindle speeds ranging from 18 to 318 revolutions per minute; these changes are obtained by operating two levers at the front of the headstock. The sliding and mating gears are made of chrome-nickel steel and are heat-treated.

The stopping and reversing lever is placed on the top of the geared headstock, and controls the operation of a friction clutch on the initial driving shaft. A hand-hole in the top cover gives easy access for adjusting the friction clutch. Change from one speed to another in one continuous movement of either of the speed-change levers is effected by a patented gear-shifting device. When the lever has reached the point where the gears are out of mesh, the driving pulley is automatically disengaged from the friction clutch, and re-engaged after the gears are again completely in mesh. This feature enables the



Cincinnati-Acme Universal Hexagon Turret Lathe built in Cone and Geared-head Types

may also be supplied. Some of the principal specifications of this machine are as follows: Swing over bed, 18 inches; swing over cross-slide, 8¾ inches; maximum distance from nose of spindle to turret face, 23 inches; transverse travel of cross-slide, 8 inches; longitudinal travel of cross-slide, 17 inches; and approximate weight, 3150 pounds.

SHORE RECORDING SCLEROSCOPE AND PNEUMATIC PEDAL

In the Model C-1 scleroscope made by the Shore Instrument & Mfg. Co., Van Wyck Ave. and Carll St., Jamaica, N. Y., which was described in December, 1921, MACHINERY, the hardness of the metal part being tested is determined by noting the height to which the hammer rebounds, relative to a vertical graduated scale. An improved instrument provided with a dial, known as the Model D recorder is now also being manufactured by this company. In the new instrument, instead of the indication being momentary, the dial hand remains fixed an indefinite length of time or until the next test is made. The mechanism consists of the usual drop-hammer, the function of which, by virtue of its accumulated energy of motion, is to overcome the penetrative resistance of the metal under test. This absorbs more or less of its striking energy, which is always constant, but that which is not absorbed, as most noticeable with the harder metals, reacts on the hammer itself, and causes it to rebound to a height proportional to the hardness of the metal.

The hammer also differs from that of the earlier models in that it is longer, heavier, and drops and rebounds a comparatively shorter distance. A sensitive one-way ball clutch and pilot sleeve normally holds the hammer in its upper starting position, but when released, the pilot sleeve falls with the hammer, so that the slightest rebound to a height above the starting position, even though it is less than 0.001 inch, is instantly fixed by the clutch. Following this cycle, the clutch is raised to its starting position, carrying the hammer with it in its now somewhat elevated position, due to being locked on the rebound. When the hammer arrives at its starting position, it engages and

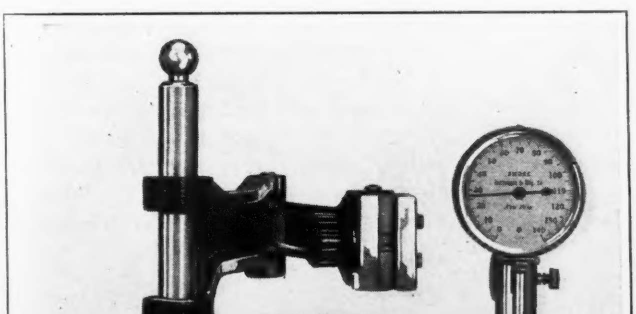


Fig. 1. Shore Scleroscope with Dial for recording the Hardness of Parts tested

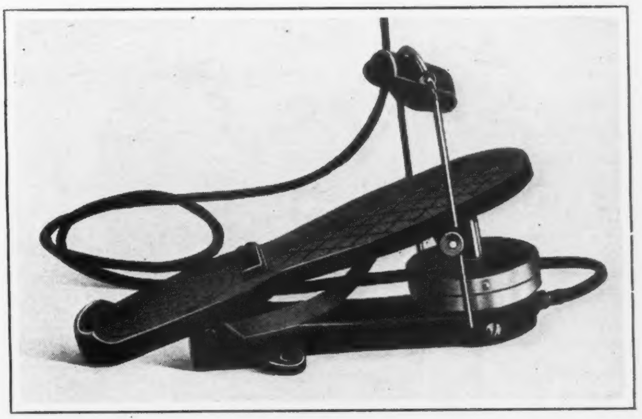


Fig. 2. Pneumatic Pedal which provides for operating the Model C-1 Scleroscope by Foot

actuates a rack and pinion and hair-spring dial mechanism, which indicates the amount of the hammer rebound, and consequently the hardness of the specimen. The hardness values obtained with this instrument agree, of course, with those indicated by the vertical scale of the older one.

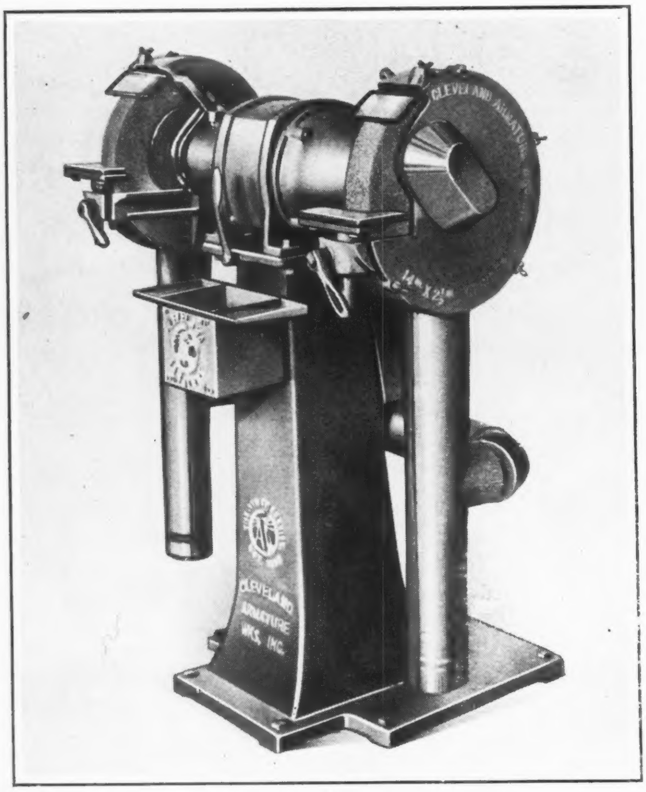
In many instances it has been found desirable to operate the Model C-1 scleroscope by foot, and to permit of such operation, the Shore Instrument & Mfg. Co. is also bringing out a pneumatic pedal known as the "Sico." This device is illustrated in Fig. 2. It is provided with an adjustable knuckle part for the top of the foot, which not only keeps the foot in place, but also permits the operator to press the pedal up and down at will, even though a spring normally actuates the up stroke. This feature serves to exercise all the foot muscles, and eliminates fatigue or cramps when the demands on the operator are prolonged. The required suction and compression is obtained by the use of a para rubber diaphragm, which is so mounted that there is practically no wear. A rubber tube is connected to the nipple of the air chamber and to the air nipple of the scleroscope.

C. A. W. ELECTRIC GRINDERS

One of a line of motor-driven grinders which is being introduced to the trade by the Cleveland Armature Works, Inc., 4732-36 St. Clair Ave., Cleveland, Ohio, is shown in the accompanying illustration. These grinders have a chrome-nickel shaft supported in Timken taper roller bearings, which may be adjusted to compensate for wear, a feature which is said to give exceptionally long life to the rotating parts. They are made in various sizes of from ½ to 15 horsepower, in speeds of 1800 and 3600 revolutions per minute, and for electric current of any phase or voltage. The machine may be mounted on a floor pedestal as illustrated, on a bench pedestal, or on a post bracket.

The motor is especially designed for hard service, having a rotor and stator of the alternating-current type, assembled by electric welding without the use of bolts, rivets, or solder. Forced ventilation is provided through dirt-proof openings, to assure cool operation at heavy overloads. The motor is controlled through a positive quick-acting switch which cannot be opened except when the current is off, and is therefore fool-proof. The switch handle can be operated by the elbow when both hands are in use. On the bench and floor types, the control mechanism, switch, and fuse cabinets are mounted on the back of the pedestal where they do not interfere with the operation of the grinder. A patented lock holds the shaft in position when wheels are being changed, and because of this design, one man can change wheels quickly without assistance.

Eye-shields of heavy glass, set in aluminum, are furnished as accessories, for ready attachment to either guard. They are adjustable, and furnish protection to the operator's eyes so that he does not need to wear goggles. The floor pedestal

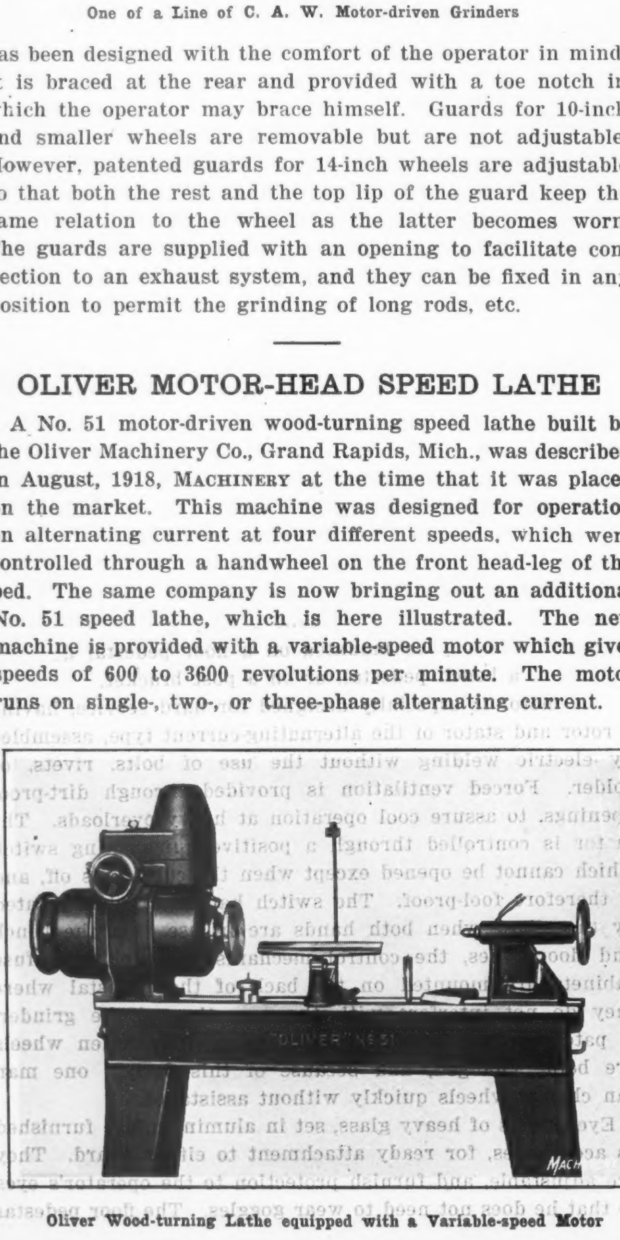


One of a Line of C. A. W. Motor-driven Grinders

has been designed with the comfort of the operator in mind. It is braced at the rear and provided with a toe notch in which the operator may brace himself. Guards for 10-inch and smaller wheels are removable but are not adjustable. However, patented guards for 14-inch wheels are adjustable so that both the rest and the top lip of the guard keep the same relation to the wheel as the latter becomes worn. The guards are supplied with an opening to facilitate connection to an exhaust system, and they can be fixed in any position to permit the grinding of long rods, etc.

OLIVER MOTOR-HEAD SPEED LATHE

A No. 51 motor-driven wood-turning speed lathe built by the Oliver Machinery Co., Grand Rapids, Mich., was described in August, 1918, MACHINERY at the time that it was placed on the market. This machine was designed for operation on alternating current at four different speeds, which were controlled through a handwheel on the front head-leg of the bed. The same company is now bringing out an additional No. 51 speed lathe, which is here illustrated. The new machine is provided with a variable-speed motor which gives speeds of 600 to 3600 revolutions per minute. The motor runs on single-, two-, or three-phase alternating current.

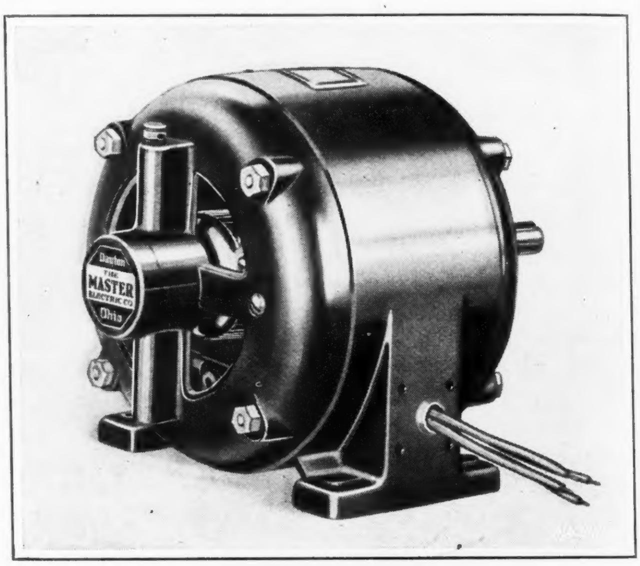


Oliver Wood-turning Lathe equipped with a Variable-speed Motor

The entire controlling mechanism is self-contained in the motor, there being no field rheostats, regulators, or relays. A push-button switch and handwheel control are regularly furnished, and through them the speed of the motor may be varied at will while it is in operation. The motor is equipped with ball bearings and a patented combined handwheel and faceplate. As a handwheel, it may be used to revolve the work or to stop the motor more quickly.

MASTER ELECTRIC MOTOR

An addition has been made to the line of electric motors built by the Master Electric Co., 448 First St., Dayton, Ohio. The new design is built in sizes of from 1/3 to 1½ horsepower. A point of interest concerning this motor is that the frame dimensions of the commutator end are identical with those of the end from which the shaft projects, the result being a very symmetrical design. This motor has interchangeable frames for the alternating- and direct-current types. Other features of design include a compact short-circuiting device, removable self-aligning bearings, and a dual wick oiling system. A feature of the repulsion-induction motor is an exceptionally high starting torque, with low current consumption. The motor is designed to start heavy overloads with so slight a drop in line voltage that there is practically no flickering of lights. The motor is also said to operate high overloads under adverse voltage conditions.

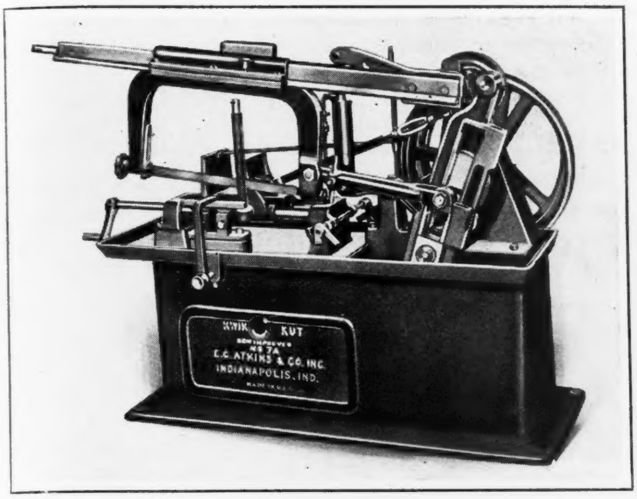


Master Alternating- or Direct-current Motor built in Sizes of from 1/3 to 1 1/2 Horsepower

ATKINS METAL-CUTTING MACHINE

The speed of operation has been practically doubled in the improved No. 7-A "Kwik-Kut" sawing machine recently placed on the market by E. C. Atkins & Co., Indianapolis, Ind. In the improved machine a speed of 100 strokes per minute is considered practicable, whereas the speed was formerly from 50 to 60 strokes per minute. The stroke is adjusted automatically to the size of the material in the vise. The saw frame travels on a T-bar and is kept in adjustment by means of screws, so that it will always travel in a straight line. The blade-holder has a gage that indicates whether or not the blade is adjusted properly relative to the vise. The blade guide rides on top of the blade, and prevents it from running sidewise while a cut is being taken.

The machine has a cabinet base which contains a compound settling tank, reservoir, and pump. The general construction of the entire machine is heavier than before, and



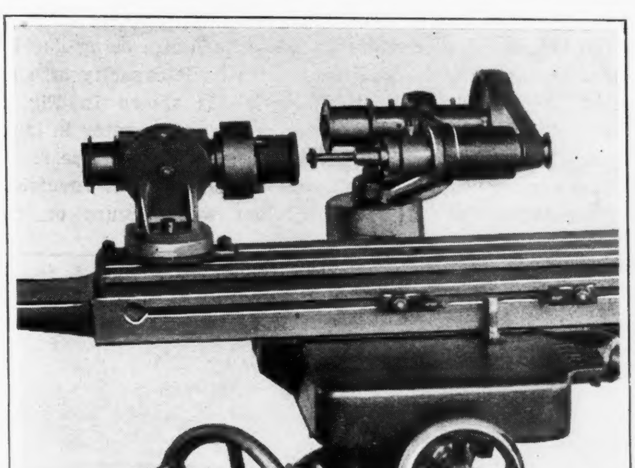
Atkins No. 7-A "Kwik-kut" Metal-cutting Machine

oil-cups are placed wherever a large amount of oil is required. The feed is controlled by a hydraulic dashpot, by means of which a greater or lesser feed can be secured by simply turning a by-pass cock. When desired, the by-pass cock can be set for a constant feed. The dashpot also acts as a cushion for the raising device, with the result that the blade is lowered into the cut without jar.

WOODS INTERNAL GRINDING HEAD

To meet the demand for an inexpensive internal grinding equipment where the amount of grinding to be performed does not warrant the purchase of a single-purpose machine, the Woods Engineering Co., Alliance, Ohio, has placed on the market a grinding head that can be used in conjunction with either the No. 2 or the 2½ universal tool and cutter grinders built by that concern. The illustration shows this head applied to the No. 2 machine. The regular work-head is employed for holding the work either in a chuck or on a faceplate.

This internal attachment replaces the regular grinding head of the machine, and the change from one head to the other can be accomplished in five minutes. The shaft, which is driven by the main belt of the machine, is mounted in ball bearings and carries a large pulley for driving the grinding spindle. The latter is mounted in ball bearings, with provision for adjusting for wear. Different lengths and diameters of stubs can be applied to the spindle nose to suit the work in hand. Adjustments may be made to maintain the proper tension on the belt that drives the grinding spindle.



Woods Internal Grinding Head mounted on Tool and Cutter Grinder

REED OPPOSED-SPINDLE DRILLING MACHINE

Drilling holes at close center distances can frequently be done to better advantage by drilling from opposite sides of the work than by drilling them on the same side by the use of an attachment. The first of these two principles has been adopted in designing the machine illustrated in Figs. 1 and 2, which is a recent development of the Francis Reed Co., 43 Hammond St., Worcester, Mass.

A special feature of this machine is the minimizing of drill breakage through the use of coil springs *A*, Fig. 2, which act in conjunction with leverage links. An adjusting means provides for regulating the pressure of these springs. The machine spindles are advanced and withdrawn from the work by operating lever *B*, Fig. 1, a crank, and links. Lever *B* reaches the stop *C* just before the points of the drills break through the work, thus allowing the compressed springs *A* to supply the power for gradually finish-drilling the holes. The spindle heads are adjustable to suit the drill length, and any length can be used. A vertical adjustment provides for varying the center distance between holes.

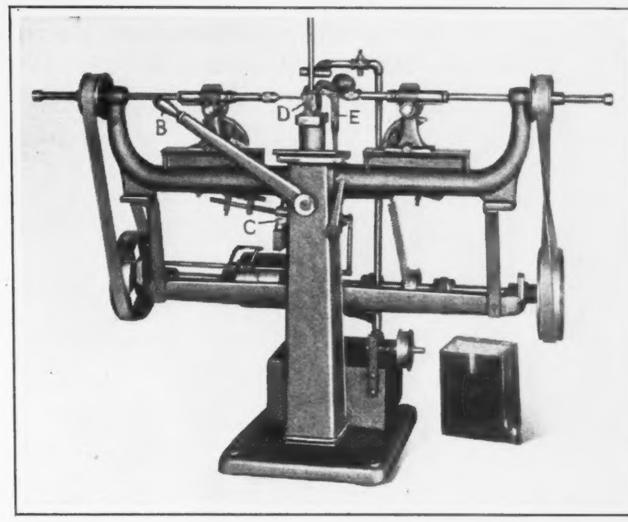


Fig. 1. Reed Drilling Machine with Opposed Spindles for drilling Work from Opposite Sides

Work-holder *D*, on the machine illustrated in Fig. 1, is intended for holding ½- and ⅝-inch round stock, a completed example being shown lying on the top of the pedestal. However, special work-holders can be devised to hold a large variety of parts. Work-holder *D* is cam-operated in conjunction with the feed-lever *B*, and held by means of a weight. On the completion of a drilling operation, lever *B*

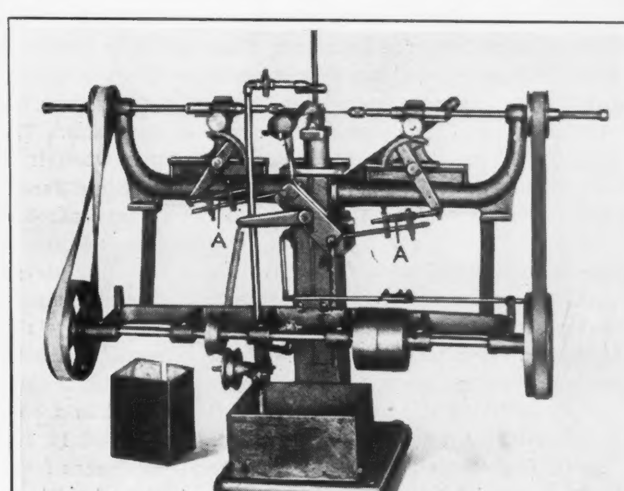
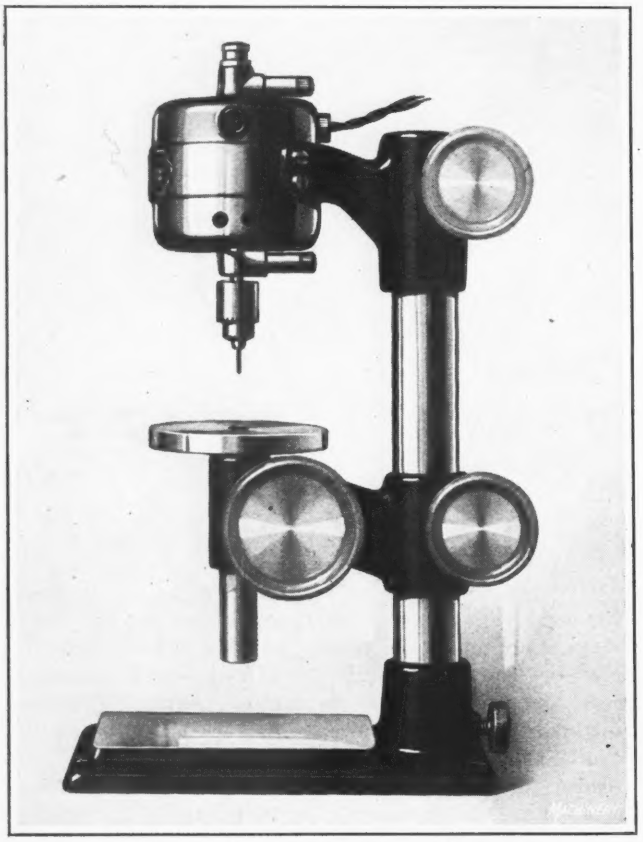


Fig. 2. Rear View of Machine illustrated in Fig. 1, showing the Compression Springs used to break the Drills through the Work

is lifted, raising the clamping lever through cam *E*, and opening the jig to allow the operator to quickly remove the finished work and insert a new piece. One hand is employed to feed the drills and the other to handle the work. The machine is furnished with an oil-supplying equipment, the tank on the floor being placed around the work-holder to catch the liquid and return it to the tank after use. A production increase of one hundred per cent over old methods is claimed for this machine.

"DUMORE" SENSITIVE BENCH DRILL

A new sensitive bench drill which has recently been added to the line of "Dumore" products manufactured by the Wisconsin Electric Co., 2556 16th St., Racine, Wis., is shown in the accompanying illustration. This drill is equipped



"Dumore" Sensitive Bench Drill for Holes up to ⅛ Inch Diameter

with a dynamically balanced "Dumore" universal motor which runs on either alternating or direct current. A ball thrust bearing takes up all end play, and wick grease-cups insure lubrication of the bearings. The spindle is furnished with a No. 0 Jacobs chuck which has a capacity up to ⅛ inch. Quick-acting locking devices make the raising or lowering of the motor and the work-table a simple operation. The motor can be easily detached from the column when it is desired to use the drill as a portable hand tool. Six different spindle speeds are obtainable by means of a foot-controlled rheostat.

The table is raised and lowered through a rack and pinion by turning a handwheel. The gear ratio of this mechanism is figured to balance the weight of the table and make the equipment so sensitive that small drills can be used without danger of breaking them. A gage set by means of a thumbscrew is provided to end the feeding of the drill when a hole has been drilled to the desired depth. The table is 3½ inches in diameter, and has the center located 3 inches from the column, which permits drilling to the center of a 6-inch circle. The table is bored and reamed at the center to suit the shanks of fixtures which form part of the regular equipment. These fixtures include cone, cup, and radius centers and a V-block. The radius center is milled to facilitate drilling rings and similar pieces. The over-all height of this drill is 16 inches.

BATH INTERNAL THREAD MICROMETER

An internal thread micrometer which has been developed by John Bath & Co., Inc., 8 Grafton St., Worcester, Mass., is shown in Fig. 1. This micrometer measures the exact size of a threaded hole and is read in the same manner as a

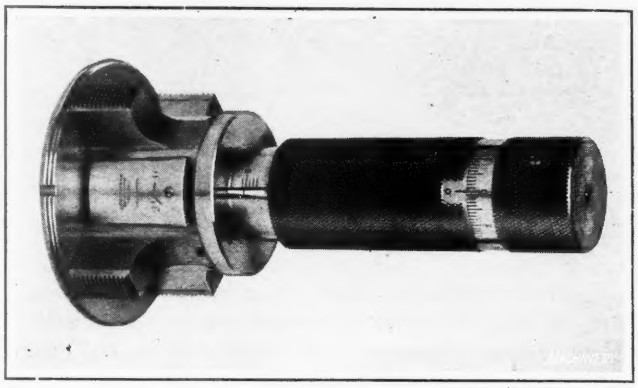


Fig. 1. Bath Internal Thread Micrometer with Threaded Pilot

micrometer caliper. It has four projecting jaws that seat firmly in inclined dovetail slots in cylindrical jaws which are actuated by means of a micrometer screw. The measuring jaws are relieved to decrease the weight and are held back against the handle by a large threaded flange which acts as a pilot and facilitates the catching of the thread in the work when the micrometer is being screwed into place. This threaded pilot is ground several thousandths inch under the nominal size, and has four notches for removing chips.

The micrometer is ground cylindrical at its minimum size so that when it is expanded in the work to the normal size, the jaws make line contact in the threaded hole. In using the micrometer, it is contracted a few thousandths of an inch under the normal size, screwed into position, and expanded until the measuring jaws contact with the threaded hole. The reading is then taken by means of the graduated dial, after which the micrometer is again contracted and removed. The micrometer can be used to measure a thread for maximum and minimum sizes—the limits being decided upon by the user anywhere within a limit capacity of 0.020 inch. An 8-inch micrometer, which is shown in Fig. 2, illustrates the possibility of making the micrometer in large sizes. It is exceptionally light for a gage of this size.

The master reference ring shown in Fig. 3 is furnished for checking the micrometer when wear occurs on the

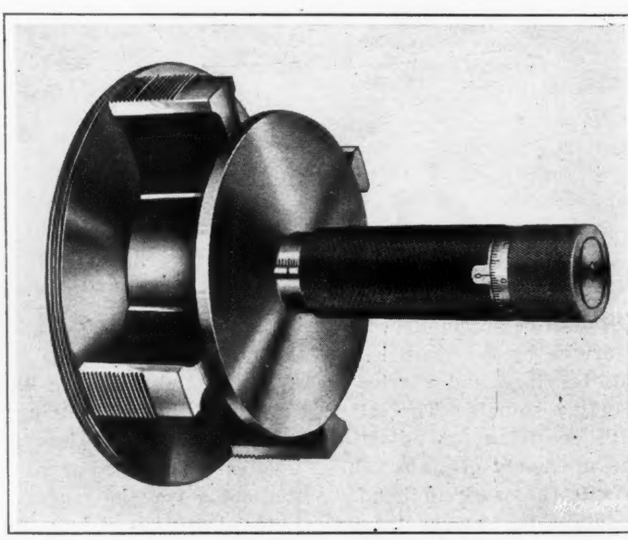


Fig. 2. Internal Thread Micrometer of Large Size

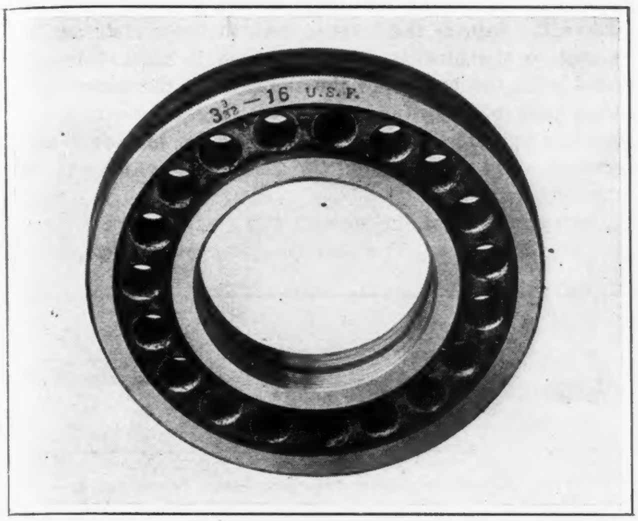
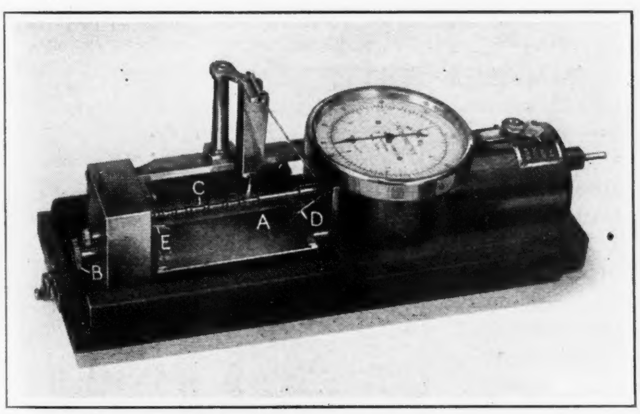


Fig. 3. Master Reference Ring for checking the Internal Thread Micrometer

measuring jaws. There is provision for setting the reading dial at zero when the micrometer is set to size by the master reference ring. The advantage of this internal thread micrometer is that it can be reground until worn out and it can always be kept up to size by referring to the master reference ring. New jaws may also be fitted by the maker.

O-Z HAND TACHOGRAPH

The number of revolutions per minute of rotating members is graphically recorded on a moving strip of paper in the "O-Z" hand tachograph shown in the accompanying illustration. This instrument is being placed on the market by O. Zernickow, 15 Park Row, New York City, for recording any speed between 30 and 24,000 revolutions per minute. The paper is fed across surface *A* by means of two rollers



O-Z Hand Tachograph for recording graphically Speeds in Revolutions per Minute

which are driven by a clock mechanism, the latter being wound by turning knob *B*. The upper roller *C* has a series of disks which contact with an ink roller and draw parallel longitudinal lines on the paper strip. The speed of the revolving member being investigated is indicated by a line drawn by pen *D* in a vertical direction relative to the direction in which the paper strip travels. This pen is set in motion by a pin projecting from the tachograph housing, and levers. The speed is indicated on the dial during the test. Pen *E* marks the time in seconds or one-fifth seconds.

The entire width of the paper strip is available to pen *D* for the different ranges of the tachograph, these ranges being controlled by the thumb-slide. This enables clear registration of even very small fluctuations in speed. The inking and printing rollers can be easily removed for cleaning and reconditioning. The weight of this instrument is two pounds. The recording mechanism may also be adapted to any type of O-Z tachometer.

PANGBORN PROTECTIVE HOOD AND APRON

When steel shot and grit are used in sand-blasting, as is quite common in foundries, there is greater wear on the hood and clothing of the operator than when sand is used, owing to the fact that the metal abrasive particles have two and one-half times the specific gravity of sand particles, and strike a blow in the same proportion without disintegration. To meet the demand for greater protection when using metal abrasive, the Pangborn Corporation, Hagerstown, Md., has placed on the market a "Shotpruf" apron and hood.

The apron has straps which pass around the neck of the operator, and spring clips which attach it to his legs. The

Pangborn "Shotpruf" Hood

clips do not bind the legs, and provide for quickly donning or removing it. The front of the apron is made of chrome leather. The hood, which is shown in the accompanying illustration, also has a chrome-leather front and crown which effectually resists wear. A finely woven wire screen, which can easily be replaced, protects the eyes of the operator and at the same time permits clear vision. The hood is made with an adjustable band that fits any size head.

ANDERSON BENCH FILING MACHINE

A filing machine of the bench type, which has been designed for use in machining all kinds of dies, forming tools, and upright cutters, is now being placed on the market by Hugold Anderson, 201 Eddy St., Providence, R. I. From the accompanying illustration it will be seen that the machine

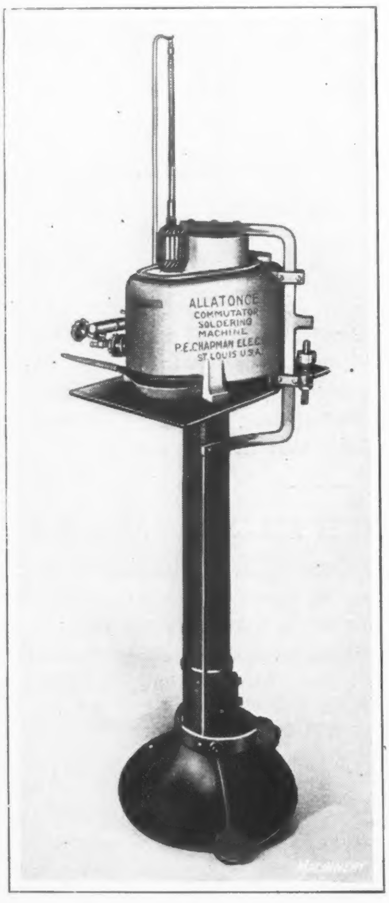
Anderson Bench Machine for filing Dies, Forming Tools, etc.

is equipped with a tilting table. This table may be swiveled up to 30 degrees both ways relative to a perpendicular, and when tilted to the maximum, the 7/16-inch hole at the center provides sufficient clearance for a ¼-inch file. This is of importance in filing narrow strips of sheet metal.

The slide is provided with a gib for taking up wear, and is so arranged that the working parts will be adequately protected from filing dust. The file-holder is made to receive ¼-inch standard machine files, and is adjustable. The belt-shifter, for changing the belt from the tight to the loose pulley and vice versa, has a spring locking arrangement. A perforated oil bushing with which the loose pulley is supplied permits of running this pulley for months without oiling. The stroke of the slide is 1½ inches; the size of the table 7 inches square; and the over-all height of the equipment, 10 inches. The proper speed of operation is from 350 to 400 revolutions per minute of the driving shaft. This machine may also be equipped with a saw frame.

CHAPMAN SOLDERING MACHINE

Commutators, rotors, containers, or other parts that require considerable soldering, may be soldered simultaneously at all joints by means of the "Allatonce" soldering machine here illustrated. This machine is a recent product of the P. E. Chapman Electrical Works, Tenth and Walnut Sts., St. Louis, Mo. It eliminates the necessity of using the slow and tedious soldering iron. The device that holds the part to be soldered also protects any desired portion of the work from contact with the solder. The latter is automatically cleaned of dross, and there is no dripping. Raising of the solder to the height of the joints to be soldered is effected by depressing the treadle at the foot of the pedestal. The burners can be adjusted for using either natural or artificial gas. A jacket protects the operator from the heat of the fire, and there is no chance of hot solder splashing on his hand. An armored thermometer, 18 inches long, is provided, which is graduated to 1000 degrees F., and 535 degrees C. The machine is built in two sizes.

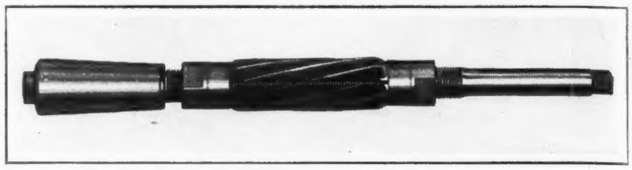


Chapman Soldering Machine

HANLON & WILSON EXPANSION SPIRAL REAMER

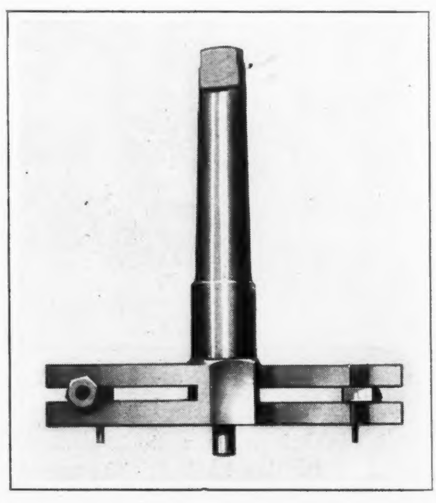
An expansion spiral reamer made up of segments containing spiral cutting edges is being introduced to the trade by Hanlon & Wilson, 321-323 Pennwood Ave., Wilkinsburg, Pa. From the illustration it will be seen that the reamer has a central spindle or arbor which is threaded for that portion of its length that is covered by the cutting segments and the means provided for holding them to the tool. This spindle has slots tapered at the bottom to form a cone relative to the axis of the spindle, and in these slots are keys or wedges the inner surface of which is tapered to correspond with the bottom of the slots, while the outer surface forms part of a cylinder. The cutting segments form a complete cylinder when assembled, except for the portions removed when cutting them from the solid cylinder in their manufacture.

The inner bore of the segments is straight and is backed centrally by a key. The segments are interlocked at their ends with the keys so as to insure proper relation with them at all times. An intermediate washer placed between the segments and the adjusting units prevents injury to the units when making adjustments. Variation in the diameter of the reamer is accomplished by moving the cutting sections along the spindle by means of the adjusting nuts. This actuates the keys in the tapered slots and expands or contracts the segments, according to the direction in which the nuts are revolved. The reamer is particularly adapted to machining holes containing oil-grooves or cavities. The minimum and maximum diameters regularly manufactured are ¾ and 1½ inches, respectively, and the range of expansion is 1/16 inch.


Hanlon & Wilson Expansion Spiral Reamer

KOCH DRILLING MACHINE CUTTER

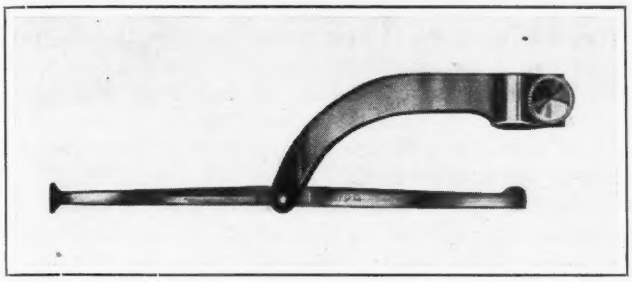
To provide an efficient means of cutting holes in fiber sheets, metal plates, and similar work, Paul W. Koch & Co., 19 S. Wells St., Chicago, Ill., are placing on the market the device here illustrated. This is known as the "Jiffy" cutter, and is similar to the hand tool, made by this firm, except that it is provided with a shank to fit a drilling machine spindle. The knives are easily adjustable to and from the shank and are renewable. Standard knives are intended for cutting metal plates up to 3/16 inch in thickness, but special knives may be supplied for cutting metal up to 1¼ inches thick. The tool may be used at a speed up to 100 revolutions per minute on fiber, and up to 50 revolutions per minute on metal. It is made in two sizes, one for cutting holes from 1¼ to 3 inches in diameter, and the other for cutting holes from 1½ to 6 inches.


"Jiffy" Cutter for cutting Holes in Fiber and Metal Sheets

BROWN & SHARPE INDICATOR ATTACHMENT

An attachment designated as No. 729 has been added to the line of precision tools made by the Brown & Sharpe Mfg. Co., Providence, R. I., in order to increase the useful-

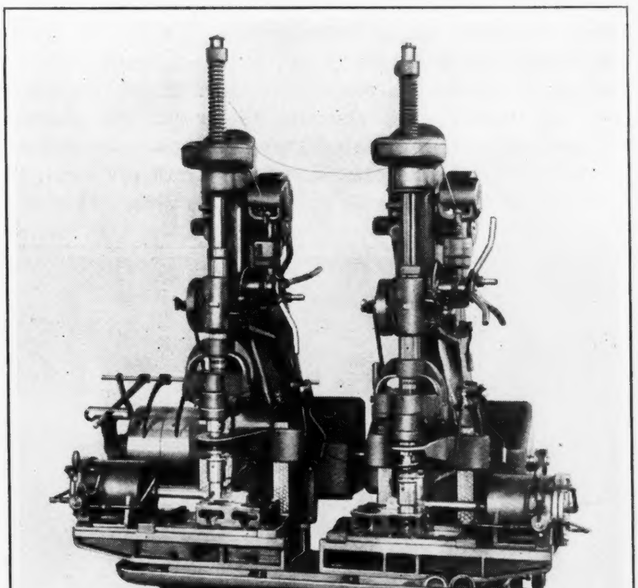
ness of the dial indicator made by this company. The new attachment adapts the indicator for testing internal and other surfaces that cannot be easily reached by means of the straight spindle with which the indicator is regularly supplied. The arm of the attachment is a bronze casting, which can be easily assembled and makes direct contact between the test bar and the dial plunger. Adjustments are unnecessary, and so there is no chance for inaccuracies. The test bar is made of steel, ground, accurately balanced, and held firmly in place by a pin driven through the arm.



Attachment for the B. & S. Dial Indicator

BARNES HEAVY-DUTY GANG DRILLING MACHINE

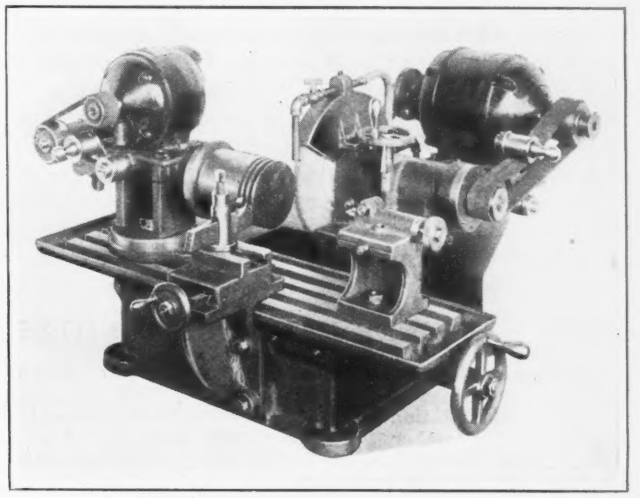
A two-spindle 22-inch heavy-duty gang drilling machine of the self-oiling and all-geared type manufactured by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill., is shown in the accompanying illustration equipped with duplex jigs having air chucks, and two-spindle auxiliary heads on each main spindle, the machine being thus arranged for tapping pressed-steel fittings for steel barrels. There are special geared thread-leading feeds to suit the pitch of the taps used in this work. Each auxiliary head carries two Rickert-Shafer collapsing taps of 2-inch pipe size. The main spindles are provided with coil springs at the top, which automatically and instantly return them upon tripping the collapsing taps. The two-position air jigs on the table enable the operator to reload the two spare positions while two pieces in the positions beneath the auxiliary spindle are being tapped. Brackets provide for resetting the chasers on the upward thrust of the spindles. Small coil springs just under the collapsing taps remove the shock at the moment of resetting. The production from this unit per operator is approximately 700 pieces per hour. The machine without the special equipment is a standard product of the company.



Barnes Two-spindle Gang Drilling Machine equipped for Tapping

FRANKLIN TURNING AND GRINDING MACHINE

A machine equipped with a grinding head at the rear and a tool carriage at the front is being placed on the market by the Franklin Machine & Tool Co., 61 Franklin St., Springfield, Mass., for turning and grinding automobile pistons, wrist-pins, valves, reseating cutters, etc. As will be seen from the illustration, the work and grinding heads are driven by individual motors. The work-head motor is of 1/4 horsepower capacity, and is mounted on a graduated swiveling base. A regular lathe spindle construction is provided for holding faceplates, draw-in collets, piston adapters, and lathe chucks. The head may be set at any angle for turning and grinding tapers, boring, and internal grinding. The turning tool is clamped in a toolpost set in a cross-slide which is operated by a feed-screw. The wheel-head motor is of 1/2 horsepower capacity, and is also mounted on a cross-slide. The handwheel at the right of the wheel guard is graduated to enable the operator to grind work to ten-thousandths of an inch. The grinding wheel is 10 inches in diameter. A belt-tightener is supplied.



Franklin T-G Model Turning and Grinding Machine

GORDON AUTOMATIC WRENCHES

A line of wrenches, the distinguishing feature of which is their automatic adjustment, has been brought out by the Automatic Wrench Co. of America, 450 Palisade Ave., West New York, N. J. This line of wrenches, as shown in the accompanying illustration, includes pipe wrenches, open-end wrenches, and wrenches similar to the familiar monkey-wrench type. All the different types can be operated by one hand. In the case of the wrench shown at the bottom of the illustration, a slight pressure of the thumb on the movable jaw instantly adjusts the wrench to the size of the nut or bolt head. To release the grip, a slight pressure on a spring in the handle is all that is necessary. The head and shank are one solid piece of metal, and the lower jaw is also made from one piece.

The pipe wrench is also so designed that it can be operated by one hand in any position. To fit it to a pipe, all that is necessary is to push the adjustable jaw forward with the thumb, until the size required is reached. When the wrench is to be released, a slight pressure on a spring in the

Three Types of Gordon Automatic Wrenches

handle acts in the same manner as described for the regular type of wrench. A valuable feature of the pipe wrench is that the top jaw can be brought back at an angle, by pressing the lower part, so that a firmer grip can be obtained.

The open-end wrench is so designed that adjustment to the size of the nut or bolt head is instantly made by a slight pressure of the thumb on the adjustment jaw, and the final tightening is obtained by giving the thumb-screw in the head of the wrench a slight turn with the thumb. The release is obtained instantly by a slight downward pressure on the knurled surface directly beneath the thumb-screw. All these wrenches are made from drop-forged 15–25 point carbon steel, casehardened, and have a rustproof finish.

* * *

NEW MACHINERY AND TOOLS NOTES

Combination Drilling Machine Table and Vise: Modern Machine Tool Co., 601 Water St., Jackson, Mich. A larger size of the combination table and vise for drilling machines described in September, 1919, MACHINERY when it was being manufactured by the Sprague-Hayes Mfg. Co., Detroit, Mich. The manufacture of the device was taken over by the Modern Machine Tool Co., as mentioned in June, 1922, MACHINERY. The vise previously described was a 16-inch size, whereas the new product is a 19-inch size, intended for use on 20-, 21- and 24-inch drilling machines. The jaws open to 10 inches. The weight is about 200 pounds.

Electric Riveting Machine: Kobert Machine Co., Inc., 50 Church St., New York City. A redesigned dual-head electric riveting machine in which a copper electrode and a steel heading set are placed side by side at the front of the machine. Heating of a rivet is accomplished by passing a current through it while it rests on the horn and is held down by the copper electrode. When the rivet has been heated sufficiently, the head of the machine is moved laterally 1¼ inches to bring the steel heading set over the work, after which the rivet head is formed under pressure. The machine is motor-driven, and controlled by a foot-pedal. The rivets are heated after being assembled in the holes of the work. By this method, the placing of hot rivets in reamed holes is avoided.

Heat-treating Gas Furnace: Fitzgerald Forging & Heat-treating Co., 576 St. James Ave., Springfield, Mass. A gas furnace known as the "Midget Universal," which is intended for use in the general heat-treating of both high-speed and carbon tool steels. The heating chamber is 6½ inches wide, 7 inches high and 9 inches long. There is also a space at the front of the furnace where tools may be preheated to approximately 1500 degrees F. before they are passed into the final chamber. Only twenty minutes is required to heat the furnace to a temperature suitable for treating high-speed steel, and a fuel consumption of only 275 cubic feet of gas is required per hour to maintain a temperature of 2400 degrees F.

1898—1923

A reception in which the entire organization of MACHINERY took part was tendered to Matthew J. O'Neill, general manager, on January 20, which was his twenty-fifth anniversary with the Industrial Press. An illustrated history of the business, covering a quarter century, signed by everyone present, and a massive silver vase, appropriately inscribed, were presented to Mr. O'Neill on that occasion.

The Industrial Press, now in its thirty-fourth year, originally owned and published four technical journals which were sold after the publication of MACHINERY was begun, and the entire efforts of the organization were concentrated on that journal and on the development of an extensive book business in the same field.

MACHINERY, now in its twenty-ninth year, is one of the few American technical journals which have continued from the beginning, for that term of years, under the same ownership and management. The development of the business during recent years is due primarily to Mr. O'Neill's ability, enthusiasm and energy.

* * *

HYDRAULIC AND ELECTRIC VARIABLE-SPEED DRIVES COMPARED

In a paper presented before the annual meeting of the American Society of Mechanical Engineers, Walter Ferris, vice-president of the Oilgear Co., Milwaukee, Wis., made a comparison between the hydraulic variable-speed drive and the electric variable-speed drive. In order to point out several advantages of the hydraulic drive, Mr. Ferris described an Oilgear drive as applied to a seven-foot boring mill.

This drive runs continuously, no friction clutch or other means of shutting down the drive being used. The service is severe and practically continuous on the day run. The over-all mechanical efficiency of this variable-speed drive at various strokes of the pump and corresponding speeds of the motor is shown by the curve in Fig. 2. The unit transmits from 10 to 15 horsepower, and with a maximum efficiency at full stroke of about 87 per cent, maintains a 70 per cent efficiency down to quarter-stroke.

According to Mr. Ferris, the advantages of this drive over an electric drive are as follows:

1. A more perfect control of the speed, permitting the operator to revolve the machine table in either direction at very slow speeds while chucking the work. The operator will frequently run his table 2 revolutions per minute, using a wrench on each clamping bolt as it comes past until the chucking is completed. If the work consists of boring a

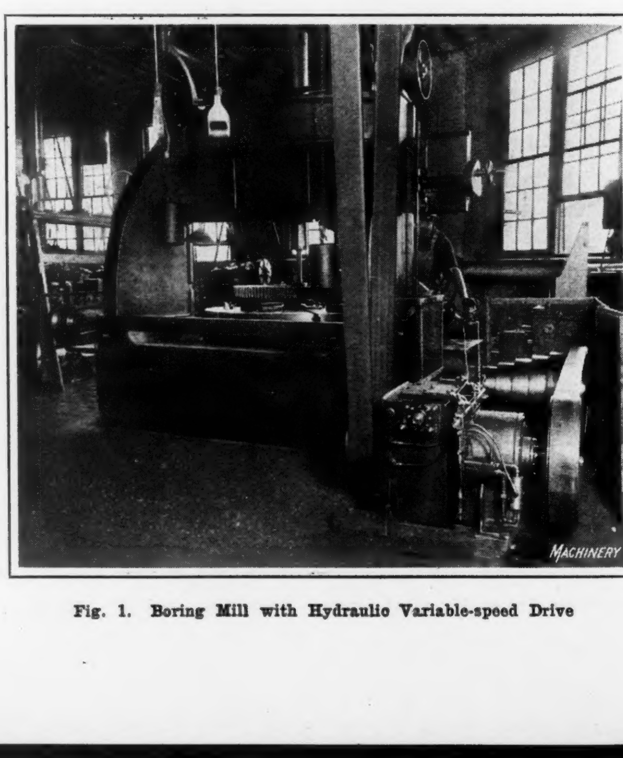


Fig. 1. Boring Mill with Hydraulic Variable-speed Drive

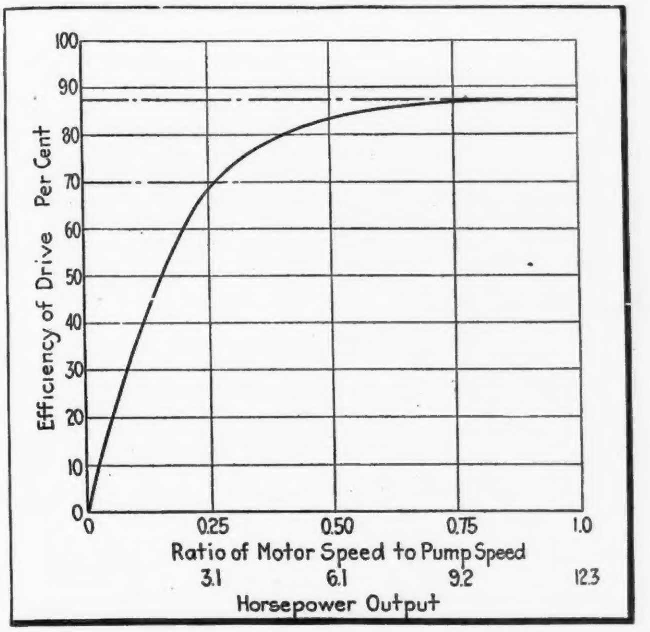


Fig. 2. Mechanical Efficiency of Hydraulic Variable-speed Drive for Boring Mill

small hole, he quickly speeds up the table to 48 revolutions per minute by merely turning the control handle of the drive.

2. No coasting when the power is shut off; the drive can be stopped from a full speed of 48 revolutions per minute in two and one-half seconds. In six seconds the table can be brought up to maximum speed in either direction. These figures include the time required to accelerate the large cone pulley of which the flywheel effect is greater than that of the table and all gearing.

3. No peak loads drawn from the line, and no heating of the hydraulic drive. When the boring mill is rapidly accelerated or stopped, as described in the preceding paragraph, the maximum accelerating torque is communicated to the hydraulic motor as soon as the hydraulic pump is a short distance off center and working at a very short stroke with small power consumption. As the pump stroke increases, with a corresponding increase of the driving speed, the power increases toward the maximum, but the draft of power during the acceleration is never in excess of the maximum running load. The mill may be started, stopped, and reversed as often as desired, without heating the hydraulic drive.

4. Low maintenance and a minimum of attention required. This particular drive has had no attention whatever for periods of from three to six months at a time. The machine operator claimed that an electric drive would have required some attention at least once a week in the way of replacing fuses, soldering connections, etc.

* * *

PRACTICAL RESEARCH

By ARTHUR L. COLLINS

When one thinks of a laboratory, the natural conception is of a place where theorists work on purely scientific problems. The patience of the scientific investigator has won him many laurels, but has not gained him the support of the man in the shop who depends on the skill and speed of his hands and rule-of-thumb methods to meet any demands for increased production that may arise.

There are many factories where a works laboratory would not be tolerated. A common expression of factory executives is, "Oh, if we had the money we might install a laboratory, but we are getting along all right now, so what's the use?" This is the attitude taken by many executives, and they will probably stick to it until they are either replaced by more progressive leaders, or their firms are forced out of business by more wide-awake competitors.

Rule-of-thumb methods of manufacturing are still adhered to in many plants, in spite of the great number of trade associations and organizations established for the mutual benefit of those engaged in practically every line of endeavor. There has been a decided awakening, however, on the part of the majority of American business men. The great amount of good to be derived from the association of men engaged in the same lines of business is becoming more clearly recognized. Men are now coming together to discuss their problems, and are telling what used to be considered trade secrets. They are looking at such things in a broader way than heretofore, and have come to realize that their own business is often benefited by a competitor's success.

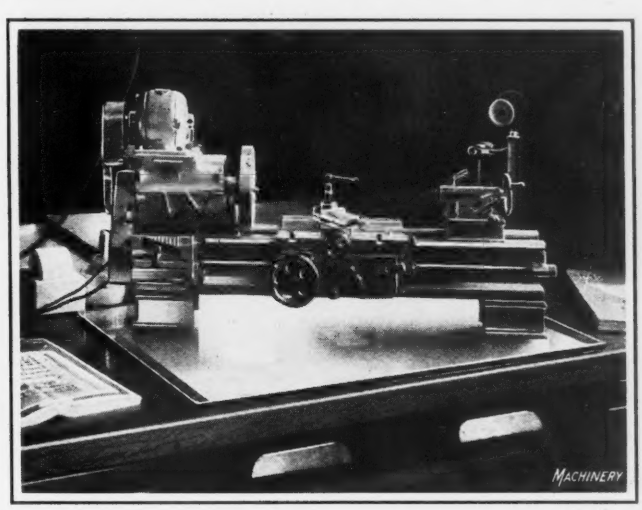
The great research laboratories of such corporations as the Eastman Kodak Co., the General Electric Co., the United States Steel Corporation, etc., have been of such inestimable value that smaller companies have been led to follow their example. The president of a large steel company recently made the statement that the science of today is the practice of tomorrow. The truth of this has been demonstrated many times, and has led to the expenditure of vast sums in purely scientific experimentations. What is considered the science of yesterday is available for the business man of today, if he will but use it. One of the best ways to do this is to establish a works laboratory and place it in charge of a scientifically trained man. Briefly stated, the functions of such a works laboratory are to apply scientific principles to the manufacture of the firm's product, so as to raise the standard of quality and still keep the cost at a minimum.

If placed in charge of the proper man, the laboratory should be the best paying department of a business. We have not as yet attained 100 per cent efficiency in any mechanical process and we probably never will, but it is the aim to eliminate as much waste as possible, and this aim must be more earnestly striven for by most American firms. Foreign manufacturers with low labor costs can compete favorably with us even with our intensive production, and it is therefore necessary to keep production costs at a minimum.

* * *

WORKING MODEL OF A LATHE

The lathe model shown in the accompanying illustration is a miniature of a Type S geared-head motor-driven lathe built by the Sebastian Lathe Co., Cincinnati, Ohio, which has a swing of 15 inches and a bed length of 6 feet. The model, which is built to one-third scale, performs all the functions of the full-sized machine. An idea of its size can be obtained by comparing it with the telephone and other objects on the desk on which the lathe rests. The model is built 90 per cent from aluminum, and weighs about 60 pounds.



Model of Sebastian Geared-head Quick-change Lathe

and Now—

A Six Inch Rule (Pocket Size) of

STAINLESS STEEL
by
BROWN & SHARPE

Rustproof—will not stain or discolor, but will always retain its bright finish—clean cut graduations in 8ths, 16ths, 32nds and 64ths, of the characteristic Brown & Sharpe accuracy.

Get one from your dealer today.
Ask for No. 350—You'll like it.

B·S
TRADE MARK

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

POWER FOR CUTTING METALS

The results obtained in a ten-year investigation made by the Kempsmith Mfg. Co., Milwaukee, Wis., into the subject of the power required for cutting metals on milling and drilling machines, lathes and planers, were discussed in a paper presented by Fred A. Parsons before the annual meeting of the American Society of Mechanical Engineers. In his summary Mr. Parsons stated that in taking slabbing or face-milling cuts, the power economy increases (1) as the number of revolutions per minute of the cutter is decreased, but only if this increases the chip thickness, as in machines having the feed rate independent of the spindle speed; (2) as the feed per revolution of the cutter is increased; (3) as the number of teeth in the cutter are decreased, but only if the number of revolutions per minute remains constant, thus increasing the chip thickness; and (4) as the front rake is increased.

Also, for spiral and slabbing cutters the power economy increases (1) as the cutter diameter is decreased, and (2) as the depth of cut is increased. For face milling cutters the power economy increases (1) as the cutter diameter is increased; (2) as the width of cut is decreased; (3) as the corner radius or chamfer is decreased; and (4) as the depth of cut is increased, but only when the blades have a rounded or chamfered corner.

With lathes, planers, etc., the power economy increases (1) as the feed per revolution or per stroke is increased; (2) as the round on the tool point is decreased; (3) as the angle of the tool face with the direction of the feed is decreased; (4) as the cutting rake is increased; and (5) as the depth is increased, but only if the end of the tool is rounded.

For drills, counterbores, etc., the power economy increases (1) as the feed per revolution is increased; (2) as the number of flutes or cutting edges is decreased; (3) as the spiral angle or cutting rake is increased; and (4) as the drill is ground with a smaller included angle of point.

While this summary points the way to a greater power economy, Mr. Parsons states that the possibilities must in many cases be subordinated to practical considerations. On a milling machine, for instance, too slow a cutter speed, too few teeth in the cutter, and too high a feed, though desirable for cutting efficiency will cause hammering, and usually the work and jigs will not stand this, even if the machine would. In certain cases this can be overcome by using helical milling cutters with a large angle of the teeth, but not always.

In certain other important details, also, a given set-up may fail in operation, even though the computed power is well within the cutting capacity of the machine. Almost any machine may be caused to chatter, or may chatter on certain speeds and feeds, even though the cut is fully within the capacity of the machine—in fact, often because the cut is too light or the cutters too sharp to put an initial strain on the supporting structure and take out the slack. More often it is due to synchronized vibrations, which are difficult to avoid for all conditions. Of two spindle speeds, both may be equally efficient in the transmission of power and have equal belt-horsepower capacity, yet the gear leverages and bearing and shaft stresses by which one is obtained may be excellent, while for the other they may be very poor, causing unsatisfactory cuts, chatter, and failure.

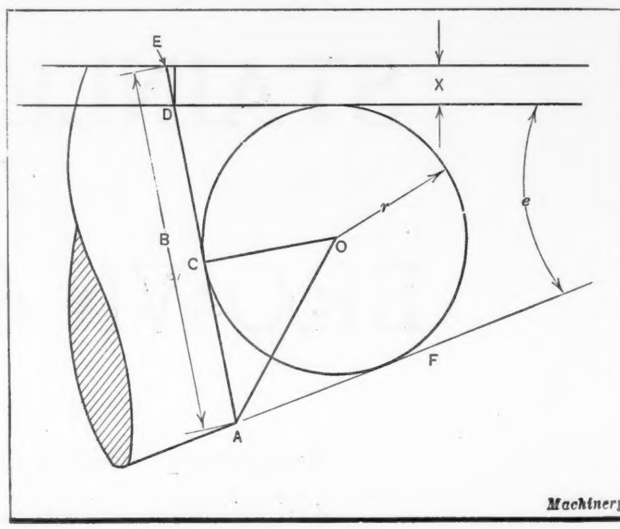
As another instance of practical limitations (though this applies only to spiral milling cutters) it might be supposed that more teeth in the cutter would give equal power economy with greater production per unit of time, provided the feed was increased to give the same average thickness of chip, because more chips would be cut per minute by the greater number of teeth. However, not only is there danger of chip interference, but if it be considered that the number of revolutions per minute for a given cutter is limited for any given material, and that the feed per revolution is limited in most cases by the finish required—which is generally accepted as being determined for spiral milling cutters by revolution marks and not by tooth marks—it will be seen that a point is soon reached where the only way left to increase the average chip thickness and obtain greater economy is to reduce the number of teeth. The only limit in this direction is, as before mentioned, the hammering action of the cutter. As the cut approaches the limit of the power capacity of the machine, the advantage of few teeth in the spiral milling cutter becomes very marked in its effect upon production.

* * *

MEASURING DIAMETER AT SMALL END OF TAPER PLUG GAGE

By C. N. PICKWORTH

A method of measuring the diameter at the small end of a taper plug gage was described on page 194 of November MACHINERY. The writer believes that the following method is somewhat simpler and more direct. Referring to the accompanying diagram, e = angle of taper, r = radius of disk, and X = the difference between the measurement taken over the plug gage and the measurement taken over



Method of measuring Diameter at Small End of Taper Plug Gage

the disk when the top edge of the gage is parallel with the surface plate.

In the diagram, angle CAO = angle $OAF = \dfrac{90 - (e \div 2)}{2}$

Hence

$$AC = r \cot\left(\frac{90-(e \div 2)}{2}\right)$$

and

$$AD = 2r \cot\left(\frac{90-(e \div 2)}{2}\right)$$

Then

$$DE = X \sec (e \div 2)$$
$$AD + DE = B$$

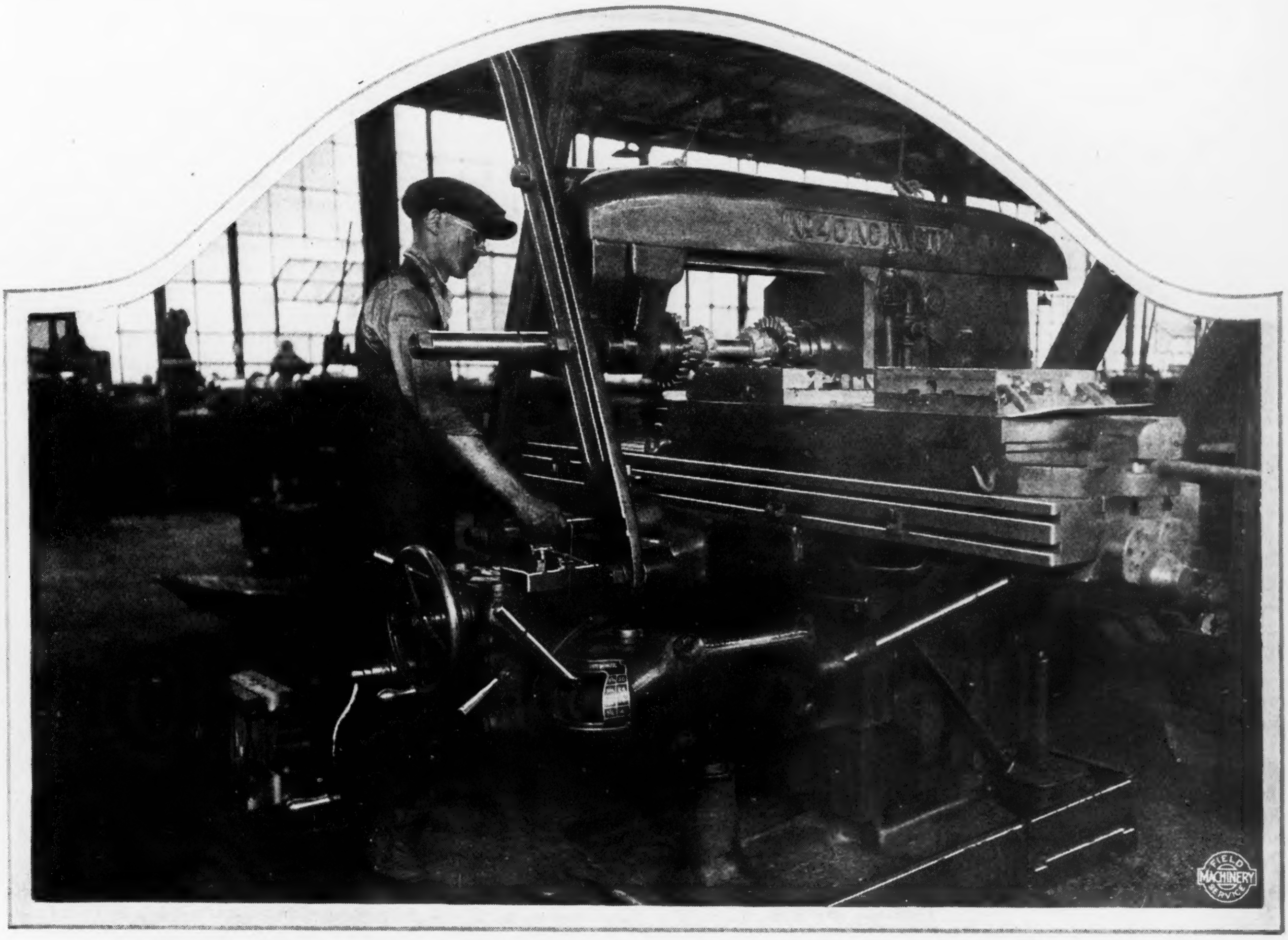
and

$$B = 2r \cot\left(\frac{90-(e \div 2)}{2}\right) + X \sec (e \div 2)$$

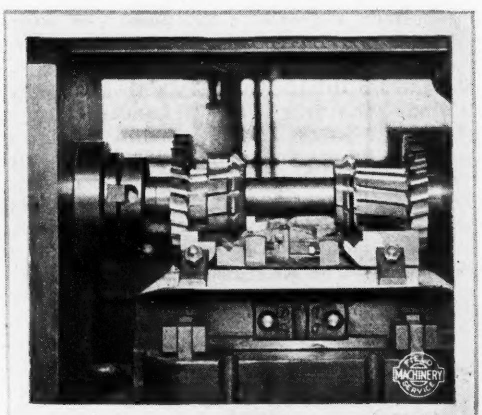
* * *

CORRECTION

In the article appearing on page 393 of January MACHINERY, "Improvised Attachment for Bevel Gear Cutting," it is stated that the attachments described are used on a Gould & Eberhardt spur gear cutting machine. This is an error, because the illustrations show a "Newark" gear cutting machine, built by the Newark Gear Cutting Machine Co., Newark, N. J.



The *Right* Way To Do This Job



A powerful drive is provided for the large gang of cutters by the flanged spindle with a 14 taper spindle hole. The self aligning Rectangular Overarm in conjunction with the outer arbor supports give the rigidity necessary to obtain the accuracy and finish required.

One of these cast-iron lathe bed carriages is finished all over to limits of .001″, ready for scraping, every 41 minutes.

Cincinnati No. 4 Plain High Power features made this time possible.

For each operation two pieces of work are mounted, one at each end of a 16″ x 36″ Index Base, held on the machine table.

Operator loads while milling. Dog controlled power quick traverse and feed practically eliminate non-productive time.

Cincinnati No. 4 and No. 5 High Power Millers possess every milling convenience. A special booklet has been prepared for your use. Send for it.

The CINCINNATI MILLING MACHINE COMPANY
CINCINNATI, OHIO

CINCINNATI MILLERS

PERSONALS

G. M. Horton, who has been general manager of the Cisco Machine Tool Co., Cincinnati, Ohio, since its incorporation, has resigned.

Marvin E. Monk has been made director of sales for the U. S. Ball Bearing Mfg. Co. of Chicago, Ill., manufacturer and distributor of ball bearings. Mr. Monk has for some time past been assistant sales manager of the company.

Arthur H. Keetch, sales representative of the Warner & Swasey Co., Cleveland, Ohio, for the Buffalo territory, with headquarters in the Iroquois Bldg., Buffalo, N. Y., has been appointed district sales manager for the Buffalo and Pittsburg districts.

Ralph L. Glaser, who for several years has been the Connecticut sales representative of the Warner & Swasey Co., Cleveland, Ohio, has been appointed New England district manager, with headquarters in the Oliver Bldg., Boston, Mass. Mr. Glaser succeeds H. L. Kinsley, who recently passed away after being with the Warner & Swasey Co. for seventeen years.

Joseph R. Sheppard, who for a number of years was hydraulic engineer in charge of the hydraulic machinery department of R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa., and who has acted as consulting engineer for the Espen-Lucas Machine Works for the last two years, has again resumed full charge of the engineering department for hydraulic machinery of R. D. Wood & Co.

J. E. Yorkston, who for the last fifteen years has been engineer in charge of the drafting department of the General Electric Co., Schenectady, N. Y., has been promoted to the position of consulting mechanical engineer. In his new capacity Mr. Yorkston will assist the designing engineers of the company in connection with important mechanical problems, and will also serve as a consulting authority in all matters pertaining to drafting practice.

C. W. Couch and Frank DeWitt have opened sales offices in the Plymouth Bldg., Cleveland, Ohio. They will represent the following companies: The Cuyahoga Steel & Wire Co., the Columbus Works Co., the Muncie Cap & Set Screw Co., and the Perry-Fay Co. Mr. Couch has been connected with the Western Automatic Machine-Screw Co. and the Perry-Fay Co. for the last twelve years. Mr. DeWitt has been connected with the Ross Mfg. Co. for the last six years as treasurer and general manager.

Fitch S. Bosworth has been appointed manager of the Chicago office of the Chain Belt Co., Milwaukee, Wis. Mr. Bosworth has been in charge of the St. Louis office for the last three years, and has specialized on chain and conveying engineering problems. Raymond X. Raymond, who has been connected for several years with the export sales department in Milwaukee, will be associated with Mr. Bosworth in the Chicago office. Thomas F. Scannell, formerly of the Chicago office, has been placed in charge of the St. Louis office. This company manufactures Rex chain conveying machinery, traveling water screens, and concrete mixers.

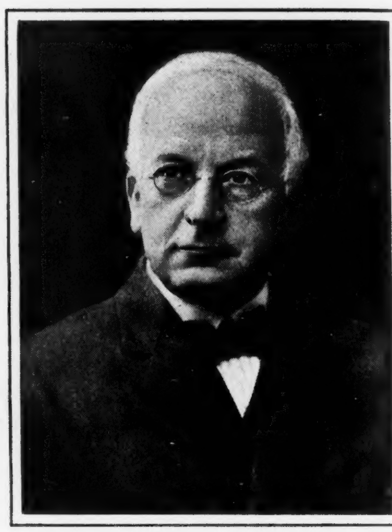
Jacques Fenwick, of the firm of Fenwick Freres & Co., of Paris, who has been in the United States for the last three months, studying industrial conditions and visiting builders of machine tools and small tools, sails for France, February 3, on the *George Washington*. Mr. Fenwick, during his visit here, made an extended trip through the country, visiting practically all the important industrial centers and spending a great deal of time in American shops and factories. He was much impressed with America, and commented on the cordial reception that he received everywhere. He also stated that he found American manufacturers always willing to cooperate with the foreign dealer in developing any possible foreign trade, although present conditions unfortunately make it very difficult to take advantage of this spirit of cooperation.

OBITUARIES

Wallace P. Hurley, for the last twelve years a member of the sales organization of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., died at New Hope, Pa., November 28, of sleeping sickness. Mr. Hurley was a graduate of Purdue University, class of 1906. In 1910 he left a position as instructor in the electrical engineering course at the Carnegie Institute of Technology to work for the Westinghouse Electric & Mfg. Co. as a correspondent in the illuminating section of the supply department, and later became manager of that department. In August, 1918, Mr. Hurley left to take a commission in the Searchlight Division of the Signal Corps of the United States Army. At the end of the war he returned to the Westinghouse Company and was assigned to the New York sales office, where he represented the company among a number of the larger central stations. He held this position at the time of his death. Mr. Hurley was a member of the American Institute of Electrical Engineers and of the Illuminating Engineering Society.

A. B. LANDIS

A. B. Landis died December 20 from heart failure, at the age of sixty-nine. Mr. Landis was one of seven children. He learned his trade as a machinist in the shops of Frank F., and Ezra F. Landis of Lancaster, Pa. In 1874 he became a partner of his brother, under the firm name of F. F. & A. B. Landis. This firm was engaged in the manufacture of small stationary engines and portable steam engines. In 1878 the business was sold to the Geiser Mfg. Co., of Waynesboro, Pa. Mr. Landis remained with this concern in charge of the tool department for a number of years, during which time he developed many new tools, and was largely instrumental in introducing interchangeable manufacturing methods in the plant. While he was connected with this company he developed the first Landis grinding machine.



In 1890 he again entered into partnership with his brother Frank F. Landis under the firm name of Landis Bros., to engage in the manufacture of cylindrical grinding machines. The plant was destroyed by fire on April 27, 1897, but within twenty-four hours a stock company had been formed under the name of the Landis Tool Co., and a new plant was quickly built. Mr. Landis was connected with this company until 1910 as mechanical engineer and superintendent.

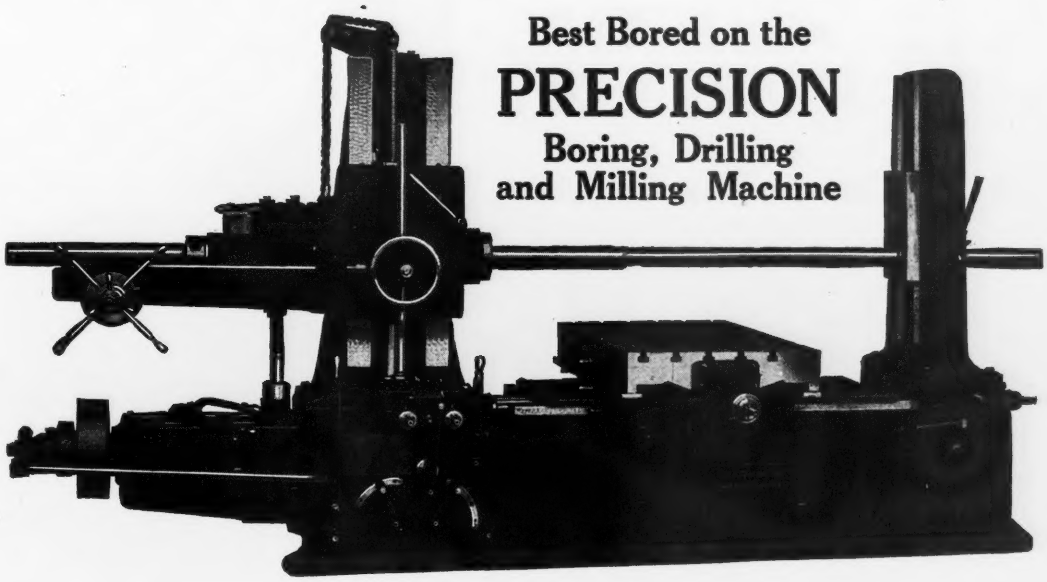
The possibilities of his grinding machine were quickly recognized by the trade, and the new company expanded rapidly to its present capacity. In 1903 the Landis Machine Co. was organized to manufacture the Landis threading machine, which was originally developed by Mr. Landis.

In the fall of 1910 Mr. Landis severed his connection with both the Landis Tool Co. and the Landis Machine Co., taking up his residence at Chestnut Hill, Philadelphia, where he opened an engineering laboratory for the development of many inventions, chief among which was a mechanical speed-change mechanism for automobiles, machine tools, etc. In the fall of 1919 he organized th firm of A. B. Landis & Sons to engage in commercial grinding and the development of mechanical ideas. He was actively connected with this business up to the time of his death.

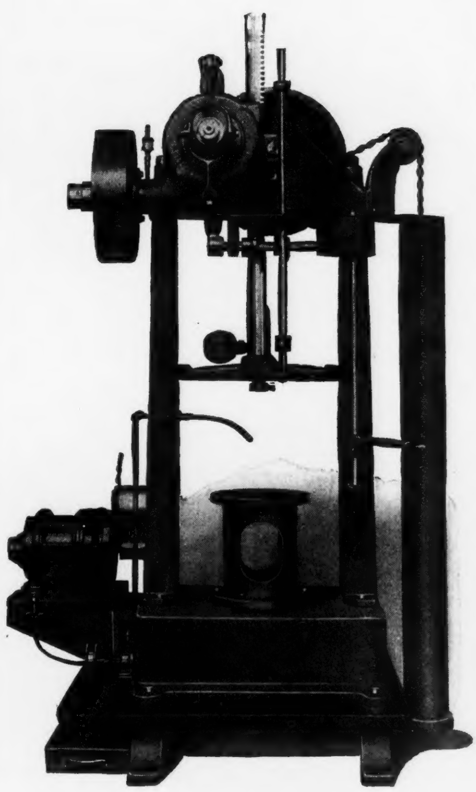
* * *

It is reported that in various parts of Germany barter is replacing the use of money; for instance, the Weimar Board governing the agricultural schools of Triptis and Marksujl has fixed the tuition for the winter term in rye instead of money, and the Saxon Thuringian Power Co., at Auma has announced that it will gladly receive, instead of cash, ten eggs, three pounds of wheat flour, or twenty-five pounds of potatoes for each kilowatt hour of electricity consumed.

HOLES

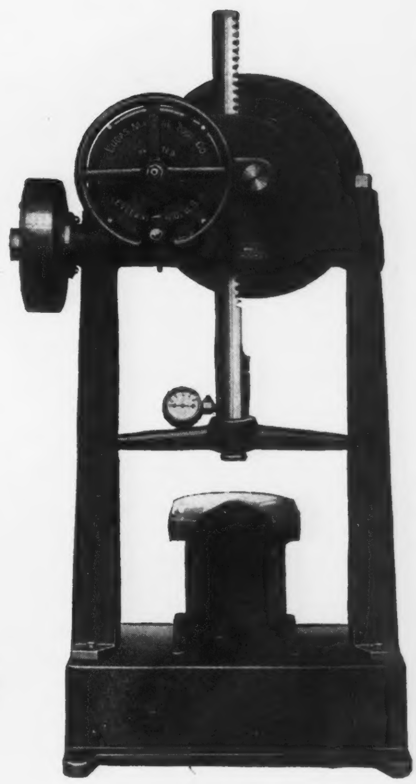


Best Bored on the
PRECISION
Boring, Drilling
and Milling Machine



Best Bushed
on the

LUCAS
POWER
FORCING
PRESS



Best Broached
on the

LUCAS
VERTICAL
BROACHING
MACHINE

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokio, Japan.

TRADE NOTES

BARBOUR, LOVE & WOODWARD, INC., dealers in machine tools and machine shop equipment, have removed their offices from 45 W. 18th St. to the Grand Central Terminal Bldg., New York City.

PRECISION & THREAD GRINDER MFG. CO., 1 S. 21st St., Philadelphia, Pa., announces that F. Rodger Imhoff, formerly sales manager and consulting engineer of the company, is no longer connected with the organization.

FOSTER MACHINE CO., Elkhart, Ind., manufacturer of turret lathes and screw machines, has established an office in New York City at 30 Church St., Room 332. E. H. Warner, formerly with the Fairbanks Co., will be in charge.

RILEY & FOSTER, manufacturers' agents, with headquarters in Baltimore, Md., and Richmond, Va., have been appointed southern representatives for the Dolman Mfg. Co., Inc., Springfield Mass., manufacturer of the Dolman screwdriver.

CLING-SURFACE CO., Buffalo, N. Y., announces that it can now supply Cling-Surface belt preservative in heavy, medium, and light consistency or in bars. This extension of the line adapts the product to all kinds of plant conditions.

INDEPENDENT PNEUMATIC TOOL CO., 600 W. Jackson Blvd., Chicago, Ill., manufacturer of pneumatic and electric tools, has appointed Blake C. Hooper of Minnesota Supply Co., Pioneer Bldg., St. Paul, Minn., as special railroad agent in the Northwest for the sale of the "Thor" line of tools.

CONSOLIDATED TOOL WORKS, INC., 296 Broadway, New York City, is represented in Illinois, Wisconsin, Minnesota, Indiana, Iowa, Missouri, Nebraska, Kansas, Michigan, North Dakota, South Dakota, Ohio, and Louisville, Ky., by Jules N. Winsten, formerly of the Bancroft Corporation, Worcester, Mass.

MASTER ELECTRIC CO., Dayton, Ohio, presented life insurance policies as a Christmas gift to all its employes, ranging from $500 up to $2000. The smaller policies will be increased each succeeding year until a limit of $2000 is reached, with all premiums paid as long as the employe remains with the company.

WAYNE TANK & PUMP CO., Fort Wayne, Ind., recently celebrated its thirtieth birthday by moving the executive offices into a new administration building. A new light-metal tank plant has also just been completed, and the painting, crating, and shipping departments have been enlarged.

OXWELD ACETYLENE CO., Newark, N. J., has recently moved its western department from 1077 Mission St., San Francisco, Cal., to larger quarters at 1050 Mission St. The western department of the company also maintains offices at Los Angeles, Portland, Seattle, Salt Lake City, and El Paso. Leo Romney is manager.

GENERAL ELECTRIC CO., Schenectady, N. Y., has allotted $37,500 to the University of Illinois, to continue an investigation relating to the fatigue of metals. The company is particularly interested in this subject because of the need of a metal that will withstand the strain of vibration to which metal is subjected in steam turbines.

ANGLO-AMERICAN INDUSTRIAL DIAMOND CO., INC., 14 W. 40th St., New York City, announces that J. S. Rose and H. R. Spandel have been appointed managers of the company, which will market in the United States the industrial diamonds of the Anglo-American Industrial Diamond Co., of London, England. The new corporation will handle industrial diamonds (bort) of all qualities and kinds.

CLEVELAND STONE CO., 1836 Euclid Ave., Cleveland, Ohio, has purchased the plant and equipment of the Sterling Grinding Wheel Co., Tiffin, Ohio, and expects immediately to enter the field of artificial abrasives. The Cleveland Stone Co., already a well-known producer of natural abrasives, has added a staff of service men and ceramic engineers to its organization, preparatory to entering the artificial abrasive field.

VAN NORMAN MACHINE TOOL CO., Springfield, Mass., builder of milling machines, internal grinders, ball raceway grinders, and bench lathes, announces that the Detroit sales office of the company is now managed (effective January 1,) by R. A. Griswold, who in the past represented the Rivett Lathe & Grinder Co. in Detroit, Mich., and in other sections of the country, and was with B. C. Ames Co., Waltham, Mass., as field representative.

METAL & THERMIT CORPORATION, 120 Broadway, New York City, has recently equipped its Jersey City welding shop for making welds on lighter sections by means of the oxy-acetylene and electric processes, this service being in addition to the present facilities of the shop for undertaking thermit welding repairs. The policy of equipping the welding shops with oxy-acetylene and electric welding facilities will later be extended to the other welding plants of the company.

GIBB INSTRUMENT CO., Bay City, Mich., manufacturer of "Zeus" welders, has taken over, under exclusive license, the manufacture and sale of the automatic and semi-automatic patented electric arc welding machines developed and heretofore manufactured by the FRED PABST CO., of Milwaukee, Wis., and has contracted to act as selling agent for the Pabst line of patented covered electrodes. The Fred Pabst Co. has spent over two years in the development of this line of equipment.

TIMKEN ROLLER BEARING SERVICE & SALES CO., Canton, Ohio, has been formed in order to add the final link in the chain of complete control that the Timken Roller Bearing Co. exercises over its product from the raw material to the sale and maintenance of the finished bearing. The new company will bring the service work for Timken bearings directly under the supervision of the Timken Roller Bearing Co. Thirty-two direct factory branches are maintained in as many of the leading cities of the United States and Canada. In addition, authorized distributors will be located in smaller cities.

ONONDAGA TRADING CO., INC., Syracuse, N. Y., moved its office about February 1 to Fourth, North, and Free Sts., where a large addition has been built to the sterilizing and washing plant. The new building in which the office is located is of modern concrete and steel construction. The total floor space of the plant has been increased from 8000 to 20,000 square feet, and the capacity from 4000 to 20,000 pounds per day. This concern specializes in the grading, washing, sterilizing and baling of wipers for use in industries where waste is often utilized. Seventeen grades are produced and sold under different brand names.

MORSE CHAIN CO., Ithaca, N. Y., has found it necessary to construct a new factory in Detroit, Mich., owing to the increasing demand for silent chain front-end drives. The company has previously operated a factory in Detroit in a leased building. The plant at Ithaca will be continued as at present. The new factory consists of a one-story building, of reinforced concrete construction, providing a total manufacturing area of 60,000 square feet, in addition to quarters for the sales and engineering offices. Provision has been made for expansion to a floor area four times that of the old plant. The Detroit factory will manufacture all the sprockets and adjustments used in Morse front-end drives.

* * *

HERRINGBONE GEAR STANDARDS

Standards for herringbone gears intended for commercial use have been prepared by the Sectional Committee on the Standardization of Gears, and presented for final approval to the American Gear Manufacturers' Association and the American Society of Mechanical Engineers, joint sponsors in the preparation of standards for gears. With respect to the tooth form, the herringbone gear standards deal with the pressure angle, addendum, dedendum, clearance, whole depth, helical angle, and dimensions to be added for the enlargement of pinions.

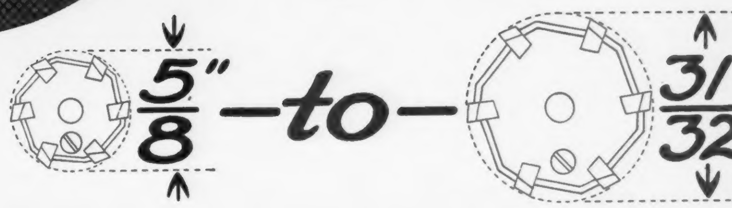
In considering the gear blank, standards are given for the following dimensions: Pitch diameter, outside diameter, minimum width of active face, and width and depth of groove at center of blank for gears cut with hobs at right angles to the axis of the gear, with single threaded hobs set at the proper angle with the axis of the gear, and by planing or shaping. A formula is also given for determining the horsepower rating for pitch line velocities up to 2000 feet per minute. Four tables and various other formulas are included in these standards. They are presented in full in the February number of *Mechanical Engineering*, published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

* * *

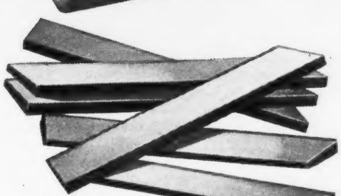
The United States Civil Service Commission has an opening for a mechanical engineer to take charge of the design, construction, and repair of the instruments used in the field and office by the Coast and Geodetic Survey and to do other related work. Applicants for this position should apply for Form 1312, stating title of the examination desired (mechanical engineer—precision instruments), to the Civil Service Commission, Washington, D. C. Applications must be filed with the Civil Service Commission prior to the hour of closing business on February 20.

Expanding Reamers

—from



5/8″ —to— 31/32″



Blades for all Wetmore Reamers

Wetmore Blades are scientifically ground to the exact bevel best suited for working various metals—steel, cast iron, bronze, etc. Best high-speed steel, ground to thickness, length and on seat. Tested for hardness and toughness. In ordering, give type and size of reamer and whether reamer is to be used on steel, cast iron or bronze.

Guaranteed Accuracy

RANGING in size by thirty-seconds from 5/8″ to 31/32″ inclusive—straight or taper shank—these Wetmore Expanding Small Machine Reamers fill a distinct need in plants where extreme accuracy and production speed are important.

In expanding these small reamers, there are no unnecessary screws to be loosened. Expansion is taken care of by a cone nut and lock nut at rear of blades. The straight blades are held securely by a special, exclusive method. These Wetmore "little fellows" set a new standard of quality, accuracy and durability. Try them and see.

There are other Wetmore Reamers, too—in designs and sizes for every need. Here are some of the important Wetmore advantages:

Adjustments to the thousandth of an inch can be made in less than a minute. In fact, the Wetmore is the quickest and easiest adjusting reamer made. Cone expansion nut keeps blades always parallel with axis.

Solid, heat-treated alloy steel body guaranteed against breakage.

Left Hand Angle Cutting Blades that prevent digging in, chattering and scoring of the reamer while backing out. Shearing effect of blades increases life of cutting edge.

No grinding arbor required for regrinding. Wetmore Reamers can be reground on their original centers.

There are several other Wetmore features you should know. Write today for our handbook-catalog which describes and illustrates the Wetmore Reamers that are becoming standard equipment in so many large plants.

Free Handbook!

Write on your business letterhead for complimentary copy of the Wetmore Reamer Reference Book. An authoritative work on latest designs of Expanding Reamers. Sent to you *free, postpaid*—without obligation to you.

Wetmore Reamer Company

60-64 27th St., Milwaukee, Wisconsin

Manufacturers of Expanding Reamers and Cylinder Reaming Sets, Arbors, Blades and Thread Gauges

WETMORE EXPANDING REAMERS

"THE BETTER REAMER"

COMING EVENTS

February 8-9 (note change of date from February 15-16)—Sectional meeting of the American Society for Steel Treating, City Club, Chicago, Ill. National secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

February 14-16—Convention of the American Institute of Electrical Engineers at the Engineering Societies' Bldg., 29 W. 39th St., New York City.

February 17-22—Exposition of inventions and patents to be held at the Grand Central Palace, New York City, under the auspices of the Universal Patent Exposition Corporation. World's Tower Bldg., 110 W. 40th St., New York City.

February 19-21—Annual meeting of the American Institute of Mining and Metallurgical Engineers at the Engineering Societies' Bldg., 29 W. 39th St., New York City.

February 27—Joint meeting of the Engineers Club of Philadelphia and the Philadelphia sections of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers at the Engineers Club, 1317 Spruce St., Philadelphia, Pa.

March 18-24—Second general meeting of the International Chamber of Commerce in Rome, Italy. Lacey C. Zapf, secretary American Section, Mills Bldg., Washington, D. C.

April 9-14—Paper Industries Exposition to be held at the Grand Central Palace, New York City. Charles F. Roth and Fred W. Payne, managers, Grand Central Palace.

April 18-20—Spring convention of the Society of Industrial Engineers, at Hotel Gibson, Cincinnati, Ohio. Further information can be obtained from the business manager of the society, 327 S. La Salle St., Chicago, Ill.

April 25-27—Tenth National Foreign Trade Convention in New Orleans, La. O. K. Davis, 1 Hanover Square, New York City, secretary.

April 28-May 3—Twenty-seventh annual convention and seventeenth annual foundry machine and equipment exhibit of the American Foundrymen's Association at Cleveland, Ohio. C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill., secretary.

May 3-5—Semi-annual meeting of the American Electro-chemical Society at Hotel Commodore, New York City. Secretary, Colin G. Fink, 327 S. La Salle St., Chicago, Ill.

May 15-18—Annual convention of the National Association of Purchasing Agents at Cleveland, Ohio. Secretary, O. H. R. Heydon, 19 Park Place, New York City.

June 25-29—Annual convention of the American Institute of Electrical Engineers at Swampscott, Mass. For further information, address the secretary's office, 29 W. 39th St., New York City.

June 25-29—Twenty-sixth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa., secretary.

NEW BOOKS AND PAMPHLETS

The Working of Steel. By Fred H. Colvin and K. A. Juthe. 245 pages, 6 by 9 inches; 135 illustrations. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City.

This is the second edition of the authors' book on the annealing, heat-treating, and hardening of carbon and alloy steels. It deals with the elements of the processes used in steel making, the composition and properties of steel, alloy steels, steels used in the Liberty engine and their application to the automotive industry, the forging of steel, annealing, casehardening, hardening of carbon and high-speed steel, furnaces, and pyrometers.

Cost Accounting Procedure. By William B. Castenholz. 335 pages, 6 by 9 inches; 70 diagrams and illustrations. Published by the La Salle University Press, Chicago, Ill.

In this book the author not only covers the underlying principles of cost accounting and their application, but also describes actual methods of keeping cost accounts. The book is particularly intended for cost accounting in manufacturing plants, and covers material costs, store records, pay-roll records, labor reports, direct labor costs, factory overhead, machine burden, factory overhead distribution, foundry cost accounting, wage systems, operation of a cost department, installation of a cost system, and many other subjects equally important in the financial management of an industrial undertaking.

Rapid Arithmetic. By T. O'Conor Sloane. 190 pages, 5 by 7½ inches. Published by D. Van Nostrand Co., 8 Warren St., New York City. Price, $1.50.

This book on arithmetic is intended to supplement the ordinary text-book. It is more general in nature than most text books on this subject, and may be said to be popular in its appeal. Quick and special methods in arithmetical calculation are given, together with a collection of puzzles and curiosities of numbers. Several variant methods are included for performing addition, subtraction, multiplication, and division. These processes are followed by fractions, decimals, interest, discount, and percentage, powers of numbers, exponents, squaring the circle, and miscellaneous material.

Mechanical World Year Book for 1923. 348 pages, 4 by 6¼ inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 1s 6d.

This is the thirty-sixth year of publication of this little handbook for mechanical engineers. Of the new matter to be found in the present edition, attention is directed to the section that is devoted to fan work; this section contains material on ventilation, conditioning of air, humidification, airways, pressure losses in duct work, drying, dust and fume removing, cupola blast, mechanical draft, etc. The section on safe loads and deflection of beams has been rewritten and new illustrations have been added. The notes on belting have also been expanded, and revisions have been made in various other sections. Among the new tables is one giving the lengths of diagonals of certain sections, and a revised table of gages. Many new illustrations have been introduced. One of the valuable features of the book is the classified buyers' directory, which is published in English, French, Russian and Spanish.

The Fundamental Principles of Purchasing. By H. D. Murphy. 83 pages, 4¾ by 7¼ inches. Published by the Purchasing Agent Co., Inc., 19 Park Place, New York City. Price, $1.50.

Ten years ago practically nothing had been written on the science of industrial purchasing. This was due to the fact that there did not exist at that time organized methods in industrial buying. However, a marked change has taken place in the past decade, and today it is becoming recognized that efficient buying is governed by certain definite principles, the same as selling and other industrial activities. The fundamental principles that make for success in buying are outlined in this book. The author is purchasing agent of the American Radio & Research Corporation, and his training and experience have been drawn upon in the preparation of the work. It contains eleven chapters, headed as follows: Preparation; What the Purchasing Agent Should Do; the Knowledge of Materials; the Knowledge of Methods; the Knowledge of Men; Picking the Source of Supply; an Order is An Order; Organization; the Order and the Law; What the Purchasing Agent Should Read; The Position Higher Up.

Hendricks' Commercial Register of the United States. 2482 pages, 8½ by 11½ inches. Published by S. E. Hendricks Co., Inc., 70 Fifth Ave., New York City. Price, $15.

The thirty-first (1923) edition of Hendricks' Annual Commercial Register contains 150 pages more than the 1922 edition, and 125,000 changes and additions were made in bringing out the new edition. This register covers completely the electrical, engineering, machinery, building, manufacturing, chemical, and all other allied industries, giving lists of manufacturers useful to both buyers and sellers. Over 18,000 products are separately classified, with the name and address of every manufacturer or producer, together with trade names or brands. This classification makes reference easy on account of the system used for indexing and cross-indexing. Many of the old classifications have been revised and regrouped, and the recent radio trade has been thoroughly classified. The names of all manufacturers included in the register, in addition to being listed under the products manufactured or handled, are also included in an alphabetical section. An alphabetical list of trade names is also given with the name and address of the manufacturer. Purchasing agents and sales managers, and others interested in the buying and selling of the products covered by the register, will find the work of great value in their business.

NEW CATALOGUES AND CIRCULARS

Sanford Motor Truck Co., Syracuse, N. Y. Bulletin containing specifications of the Sanford six-cylinder motor truck known as the "Greyhound."

Louis Allis Co., Milwaukee, Wis. Bulletin 406, outlining the distinguishing features of the L-A heavy-duty motor, and describing the details of construction. Complete information is given on the various types.

Botwinik Bros., 21 Sylvan Ave., New Haven, Conn., dealers in machinery and mill supplies, with branch offices at 28-42 Drouve St., Bridgeport, Conn., is distributing a calendar for 1923 to the trade.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. Circular illustrating and giving specifications for the "Thor" pneumatic safety rivet buster, which is capable of cutting off and backing out rivets of all sizes.

Midwest Steel & Supply Co., Inc., 28 W. 44th St., New York City. Folder entitled "Steel Sections for Overhead Shafting and Anchorage Problems," illustrating and describing the company's products, which comprise box rails and steel stringers.

Whiting Corporation, Harvey, Ill. Bulletin 159 (superseding No. 141), dealing with the operation and the maintenance of Whiting electric cranes. Lists of repair parts are given, together with halftone illustrations of the different parts, numbered so that they may be easily ordered.

Elecdrive Mfg. Co., Inc., Syracuse, N. Y. Catalogue describing the construction and operation of the Elecdrive universal wrench, drill, stud, and screwdriver, which is equipped with off-set spindles, permitting operation in close quarters. The dimensions and prices of the different sizes are included.

Geneva Metal Wheel Co., Geneva, Ohio. Catalogue 16, illustrating and describing the Geneva steel wheels suitable for all kinds of portable outfits that do not run on rails, with the exception of automobiles. Among the types of wheels shown are industrial truck wheels for light and heavy duty.

Consolidated Tool Works, Inc., 296 Broadway, New York City. Catalogue D, illustrating and describing the company's pilot brand tools, including hacksaw frames, bit braces, planes, hand drills, breast drills, spring calipers and dividers, adjustable tap wrenches, tool- and tap-holders, self-reading micrometers, and screwdriving sets.

Edgar T. Wards Sons Co., Boston, Mass. Catalogue giving dimensions, prices, and other data of cold-rolled or cold-drawn steel, sheet steel, spring steel, steel tubing, and various brands of tool steel. General information is also included, as for example, automobile specifications for steel, metric equivalent tables, data on standard gages, and weight tables.

Alexander Milburn & Co., 1416 W. Baltimore St., Baltimore, Md. Miniature catalogue covering the Milburn line of welding and cutting equipment, which includes acetylene welding generators, compressing plants, oxy-acetylene plants, welding and cutting torches, oxygen, hydrogen, and acetylene regulators for welding or cutting, gages, welding rods, preheaters, etc. Copies will be sent upon request.

New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheets, Nos. 9, 11, 12, 23, 24, 29, 32 and 33 FE, illustrating and describing installations of ball-bearings in mine car-wheel mountings, grinding or polishing heads, toolpost high-speed grinding spindles, machine tool change-speed gearing, equalizing wood saws, variable feed-change speed gear-box and table elevating mechanism of boring mills, worm-drive shaft mounting, and swing saws.

Cincinnati Planer Co., Cincinnati, Ohio. Catalogue entitled "Planer Operations," containing a large number of illustrations of actual installations of Cincinnati planers, indicating the capacity of these machines and the classes of work which they are particularly adapted to handle. A brief description of each job is included. The catalogue also contains a list of concerns using two or more of these planers and a partial list of railroads using Cincinnati planers.

Wisconsin Electric Co., 2556 Sixteenth St., Racine, Wis. Circulars illustrating and describing "Dumore" portable grinders and drills. The circulars are illustrated with views showing applications of these tools on various classes of work. The portable drills are made in three models, 1-BD, 2-BD, and 2-AD, having capacities for drilling holes ¼ and ⅛ inch in diameter in steel, and are intended particularly for light production work requiring speed and accuracy, and for general repair and emergency work.

W. A. Jones Foundry & Machine Co., 4409 W. Roosevelt Road, Chicago, Ill. Catalogue 26, containing information relative to Jones spur gear speed reducers. This catalogue comprises a complete treatise on speed reduction drives, and is intended for consulting engineers, superintendents, chief engineers, master mechanics, and any one who specifies mechanical drives for factories, mills, mines, or plants. It contains technical information, complete descriptive matter, and illustrations of typical drives. One section of the catalogue shows pictorially installations of reducer drives in many large industrial plants. Dimensions, weights, and horsepower ratings for complete speed reduction sets are also given.

Norton Co., Worcester, Mass. Treatise on grinding, comprising 387 pages, 5 by 7½ inches, bound in green cloth. This a book dealing with the wheels, machines, and methods employed in modern grinding practice, and containing information as to the production and application of abrasives, grinding wheels, and grinding machines. The book has been compiled by members of the executive and technical staffs of the Norton Co., and covers the practice of grinding in a comprehensive manner. An idea of the subjects dealt with can best be given by reference to the chapter heads, as follows: Definition and Field of Grinding; Abrasives; Manufacture of Grinding Wheels; Selection of Grinding Wheels; "Hand" and Semi-precision Grinding; Tool and Cutter Grinding; Machines for Precision Grinding; the Cylindrical Grinding Machine; Efficient Production of Cylindrical Work; Steadyrests; Crankshaft Grinding; Roll Grinding; Form Grinding; Cam Grinding; Plain Surface Grinding; Internal Grinding; Miscellaneous Applications of Grinding; Polishing and Lapping; Devices for Truing and Dressing Grinding Wheels; Care and Safe Use of Grinding Wheels; Operation of Grinding Wheels in Machine Grinding. The price of the book is $1.